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WEATHER BUREAU
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MONTHLY WEATHER REVIEW

VOLUME 45, No. 6

JUNE, 1917

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NOTICE TO CONTRIBUTORS.

Contributions intended for publication in any given issue of the MONTHLY WEATHER REVIEW (e. g., January) should be in the hands of the editor before the end of the next following month (e. g., February), if no illustrations are required. When the paper is illustrated, the manuscript and the copy for illustrations must be submitted much earlier, in order to permit copy being prepared for the engraver by the end of the month.

REPRINTS are made up without covers in the original size and pagination of the REVIEW. They will not be furnished unless specifically REQUESTED WHEN THE MANUSCRIPT IS SUBMITTED.

MONTHLY WEATHER REVIEW

CLEVELAND ABBE, jr., Editor.

VOL. 45, No. 6.
W. B. No. 622.

JUNE, 1917.

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INTRODUCTION.

As explained in this introduction during 1914, the MONTHLY WEATHER REVIEW now takes the place of the Bulletin of the Mount Weather Observatory and of the voluminous publication of the climatological service of the Weather Bureau. The MONTHLY WEATHER REVIEW contains contributions from the research staff of the Weather Bureau and also special contributions of a general character in any branch of meteorology and climatology.

SUPPLEMENTS TO THE MONTHLY WEATHER REVIEW are published from time to time.

The climatological service of the Weather Bureau is maintained in all its essential features, but its publications, so far as they relate to purely local conditions, are incorporated in the monthly reports "Climatological Data" for the respective States, Territories, and colonies.

Beginning August, 1915, the material for the MONTHLY WEATHER REVIEW has been prepared and classified in accordance with the following sections:

SECTION 1.—*Aerology.*—Data and discussions relative to the free atmosphere.

SECTION 2.—*General meteorology.*—Special contributions by any competent student bearing on any branch of meteorology and climatology, theoretical or otherwise.

SECTION 3.—*Forecasts and general conditions of the atmosphere.*

SECTION 4.—*Rivers and floods.*

SECTION 5.—*Seismology.*—Results of observations by Weather Bureau observers and others as reported to the Washington office.

SECTION 6.—*Bibliography.*—Recent additions to the Weather Bureau library; recent papers bearing on meteorology.

SECTION 7.—*Weather of the month.*—Summary of local weather conditions; climatological data from regular Weather Bureau Statistics; tables of accumulated and excessive precipitation; data furnished by the Canadian Meteorological Service; monthly charts Nos. 1, 2, 3, 4, 5, 6, 7, 8, the same as hitherto; Meteorological Summary and chart No. 9 of the North Atlantic Ocean for this month in 1916. Owing to the fact that ocean meteorological data are frequently not available for a considerable time after the close of the month to which they relate, the chart and text matter in connection therewith appear one year late.

In general, appropriate officials prepare the seven sections above enumerated; but *all students of atmospherics are cordially invited to contribute such additional articles as seem to be of value.*

The voluminous tables of data and text relative to local climatological conditions, that during recent years were prepared by the 12 respective "district editors," are omitted from the MONTHLY WEATHER REVIEW, but collected and published by States at selected section centers.

The data needed in Section 7 can only be collected and prepared several weeks after the close of the month designated on the title-page; hence the REVIEW as a whole can only issue from the press within about eight weeks from the end of that month.

It is hoped that the meteorological data hitherto contributed by numerous independent services will continue as in the past. Our thanks are specially due to the directors and superintendents of the following:

The Meteorological Service of the Dominion of Canada.
The Meteorological Service of Cuba.
The Meteorological Observatory of Belén College, Habana.
The Government Meteorological Office of Jamaica.
The Meteorological Service of the Azores.
The Meteorological Office, London.
The Danish Meteorological Institute.
The Physical Central Observatory, Petrograd.
The Philippine Weather Bureau.

The Weather Bureau desires that the MONTHLY WEATHER REVIEW shall be a medium of publication for contributions within its field, but such publication is not to be construed as official approval of the views expressed.

CORRIGENDA.

REVIEW, May, 1917:
Page 217, column 2, line 33, *for* "July 31, 1913" *read* "July 30, 1913."

5720—17——1

SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING JUNE, 1917.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Washington, D. C., July 27, 1917.]

For a description of instrumental exposures and an account of the methods of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1917, **45**:2.

The monthly means and departures from normal values given in Table 1 show that direct solar radiation averaged below normal intensity at Washington, D. C., and Lincoln, Nebr., and was very close to normal intensity at Madison, Wis.

From the radiation intensities measured at Madison on June 20 and 29 are obtained 1.94 and 1.97, respectively, for the value of the solar constant; while from the a. m. measurements obtained at Lincoln on the 7th, 10th, and 14th, the values 1.88, 1.97, and 2.00, respectively, are obtained. The mean for each station is 1.95.

Table 3 shows only unimportant departures from normal radiation at Washington, but a deficiency of about 13 per cent at Madison.

Skylight polarization measurements at Washington give a mean of 44 per cent, with a maximum of 51 per cent, which are each considerably below the corresponding June average. The measurements at Madison give a mean of 59 per cent, with a maximum of 66 per cent.

TABLE 1.—*Solar radiation intensities during June, 1917.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
June 4	1.26									
8				0.86	0.80	0.76	0.69	0.64		
9		1.15	1.02	0.92	0.85	0.78	0.72	0.67		
14			0.94	0.71						
15				0.72						
16							0.52	0.47	0.42	
17			0.91	0.76						
18	1.18	1.10	1.03				0.51	0.45		
19	1.19	1.05	0.91	0.80	0.71	0.62	0.56	0.51		
20	1.10	0.95		0.73						
21			0.88	0.69						
22		0.98	0.78	0.73						
25	1.26	1.09	0.86							
30		1.05	0.93							
Monthly means	**1.20**	**1.05**	**0.92**	**0.77**	**0.79**	**0.72**	**0.60**	**0.55**	**(0.42)**	
Departure from 9-year normal	**−0.08**	**−0.05**	**−0.01**	**−0.06**	**−0.03**	**−0.05**	**−0.08**	**−0.05**	**−0.10**	
P. M.										
June 4		1.09	0.86	0.74	0.64	0.57	0.51	0.46		
18		1.07	0.89	0.80						
22		0.89								
25		1.08	0.87							
Monthly means		**1.03**	**0.87**	**(0.77)**	**(0.64)**	**(0.57)**	**(0.51)**	**(0.46)**		
Departure from 9-year normal		**−0.06**	**−0.16**	**−0.14**	**−0.20**	**−0.15**	**−0.19**	**−0.10**		

TABLE 1.—*Solar radiation intensities during June, 1917*—Continued.

Madison, Wis.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
June 8	1.24									
11					0.74	0.67				
12	1.31	1.20	1.11	1.03						
13	1.45									
16	1.37	1.29	1.20		1.04	0.97	0.91	0.84		
19			1.17	1.08	0.99					
20	1.38		1.13	1.04	0.94	0.86	0.80	0.74		
29	1.36	1.23	1.11	1.01	0.93	0.87	0.79	0.74		
Monthly means	**1.35**	**1.24**	**1.14**	**1.04**	**0.93**	**0.84**	**0.83**	**0.77**		
Departure from 7-year normal	**+0.04**	**+0.03**	**+0.02**	**−0.01**	**−0.03**	**−0.06**	**−0.03**			
P. M.										
June 8		0.87								
12		1.17								
13		1.29								
29		1.23	1.12	1.02						
Monthly means		**1.14**	**(1.12)**	**(1.02)**						
Departure from 7-year normal		**+0.01**	**−0.06**	**−0.05**						

Lincoln, Nebr.

A. M.										
June 7	1.30	1.18	1.04	0.89	0.76	0.67	0.65			
10	1.32	1.19	1.04	0.90	0.79	0.70	0.67			
11	1.30	1.11	0.99	0.86	0.76	0.67	0.61			
13	1.51	1.36								
14	1.49	1.37	1.26	1.13	1.01	0.94	0.84			
19	1.46									
23	1.38									
29	1.36									
30	1.36	1.18	1.08	0.92						
Monthly means	**1.39**	**1.23**	**1.08**	**0.94**	**0.83**	**0.74**	**0.69**			
Departure from 2-year normal	**+0.02**	**−0.07**	**−0.08**	**−0.12**	**−0.14**	**−0.14**	**−0.09**			
P. M.										
June 6				0.85	0.76	0.72	0.65			
7		1.18	1.03	0.89	0.80	0.73	0.65			
11		1.15	1.03	0.96	0.91	0.83	0.74			
13		1.34	1.20	1.10	1.01	0.95	0.89			
14		1.38	1.23	1.12	1.03	0.97	0.88			
21				1.00	0.93	0.83				
23		1.23	1.15	1.06	0.94	0.84	0.77			
29		1.14	1.00							
30		1.13	0.93	0.81	0.70					
Monthly means		**1.22**	**1.08**	**0.97**	**0.88**	**0.84**	**0.76**			
Departure from 2-year normal		**−0.01**	**−0.03**	**−0.04**	**−0.04**	**−0.03**	**−0.02**			

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Dates.	A. M.	P. M.	Dates.	A. M.	P. M.	Dates.	A. M.	P. M.	Dates.	A. M.	P. M.
1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*
June 4	7.57	9.83	June 8	8.81	10.59	June 6	7.29	7.87	June 5	3.00	2.62
8	13.13	10.97	11	10.21	5.11	7	7.87	10.21	6	3.30	1.96
9	12.68	15.11	12	14.10	17.37	10	10.59	15.11	7	2.62	1.96
14	17.37	15.11	13	9.47	9.47	11	15.65	10.21	8	3.00	3.45
15	10.59	10.59	16	7.04	9.47	13	8.81	7.29	9	5.16	3.00
16	8.48	8.18	19	9.83	10.59	14	6.02	8.18	11	2.62	1.88
17	8.18	10.59	20	9.47	11.38	19	8.81	10.97	12	3.30	1.68
18	9.47	11.38	29	12.24	12.24	21	11.38	11.38	13	3.15	4.37
19	10.97	13.13	.....	.....	.....	23	12.24	13.61	14	3.81	4.57
20	13.61	15.65	.....	.....	.....	29	15.65	16.79	20	5.36	2.62
21	13.61	13.13	.....	.....	.....	30	12.24	16.20	29	6.76	4.57
22	12.24	15.65	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	16.20	10.97	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	12.68	13.13	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE 3.—*Daily totals and departures of solar and sky radiation during June, 1917.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.		Departures from normal.		Excess or deficiency since first of month.	
	Washington.	Madison.	Washington.	Madison.	Washington.	Madison.
1917.	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*
June 1	527	327	37	−159	37	−159
2	498	55	8	−433	45	−592
3	632	657	143	167	188	−425
4	701	227	212	−265	400	−690
5	479	165	−10	−329	390	−1,019
6	386	158	−104	−339	286	−1,358
7	314	152	−178	−347	108	−1,705
8	420	697	−74	195	34	−1,510
9	621	611	124	106	158	−1,404
10	303	661	−196	153	−38	−1,251
11	204	561	−297	51	−335	−1,200
12	482	681	−22	168	−357	−1,032
13	449	459	−57	−57	−414	−1,089
14	350	310	−158	−209	−572	−1,298
15	299	534	−211	12	−783	−1,286
16	530	769	18	245	−765	−1,041
17	727	663	213	136	−552	−905
18	682	500	167	−30	−385	−935
19	666	582	149	49	−236	−886
20	533	720	14	185	−222	−701
Decade departure					**−184**	**550**
21	519	588	−1	50	−223	−651
22	611	309	89	−232	−134	−883
23	475	221	−49	−323	−183	−1,206
24	596	408	71	−138	−112	−1,344
25	701	340	175	−207	63	−1,551
26	599	661	73	114	136	−1,437
27	486	370	−39	−178	97	−1,615
28	512	146	−13	−402	84	−2,017
29	393	714	−131	166	−47	−1,851
30	637	374	113	−174	66	−2,025
Decade departure					**288**	**−1,324**
Excess or deficiency since first of year. (gr.-cal					**−2,475**	**+147**
Excess or deficiency since first of year. (per cent					−3.7	+0.2

PECULIAR STREAK IN LINE WITH KITE WIRE.

By BERTRAM J. SHERRY, Meteorologist.

[Weather Bureau Aerological Station, Drexel, Nebr., July 19, 1917.]

During the Weather Bureau kite flight of July 9, 1917, at Drexel, Nebr., while 4 kites were in the air flying tandem on 7,200 feet of wire, there appeared suddenly in the sky, outlined against an irregular, circular patch of what was thought to be cirrus clouds, a clear, blue streak, apparently a rift in the clouds, directly in line, but evidently beyond the kite wire. This streak appeared to stand vertically in the sky due south of the station. It was ¾° wide and 15° long, extending from 30° to 45° elevation. The streak appeared suddenly at 9:15 a. m.; it was seen by the writer, who called the other two men, then in the reel shelter, to witness the phenomenon. The streak, as it was observed, appeared to be along the kite wire; but as it is believed that the clouds were much higher than the kite wire at this time, and as the streak appeared to divide the clouds, there is some question as to whether it was caused by reflection of light from the kite wire, or from some electrical effect of the wire that caused the clouds to dissipate. The streak was clearly visible and well defined. At 9:16 a. m. the streak lost its clean-cut appearance, changing gradually into a zigzagged path through the clouds, and at 9:17 a. m. it had disappeared. At 9:18 a. m. the patch of clouds had dissipated. The sun was shining brightly all of the time the streak was observed, being 45° high and 75° to the left of the position of the streak. The head kite was flying at an angle of 57° above the horizon when the streak was observed and was approximately 5,800 feet above the ground. The electrical potential on the kite wire, due to atmospheric electricity, was 750 volts at 9:16 a. m., which later decreased.

On only two other occasions during the writer's experience of eight years in kite flying, streaks similar to the one described above have been observed. At Mount Weather, Va., on December 11, 1908, the following note was made concerning the flight made on that day:

> A few minutes after the head kite had disappeared in the clouds a long white streak of light was visible directly in line with the kite wire. The streak of light was probably 1,500 feet long. The kite wire was very heavily charged with electricity. The light streak remained visible for a few minutes, then gradually became zigzagged, and faded from sight. About five minutes later the head kite broke away. The clouds were broken stratus when the streak was first observed, but as the streak faded the clouds became an unbroken mass of stratus, and just before the kite broke away the electric charge on the kite wire vanished.

On January 2, 1909, at Mount Weather, Va., the following note regarding the flight of that day was made:

> While reeling in, and while the head kite was in thin strato-cumulus clouds, a long streak of light, extending from the head kite to the second kite, was visible for about one minute. The wire seemed to dissipate the clouds immediately surrounding it. These clouds were about a mile high.

On each occasion when these streaks were observed they were witnessed by at least two persons whose impressions were essentially the same as those given above. In the cases observed at Mount Weather the streaks seemed to be caused by some influence of the kite wire dissipating the clouds immediately surrounding it, while at Drexel this was not so plainly indicated and it seemed possible that the streak might be due to the reflection of light by the kite wire.

The streaks observed in each instance seemed to be about the same length, about the same height above the ground, to appear as a clean cut streak ¾° wide and 15° long, to last about a minute, then to become zigzagged, and later to fade gradually from view. In the two cases at Mount Weather there is no question but that the kite wire was actually in the clouds, and in those instances the streak was a light streak in a dark colored cloud, while in the case at Drexel it is believed that the kite wire was not as high as the clouds, the clouds were much thinner than in the other cases, and the streak appeared as a well-defined, straight path of blue sky in a light colored cloud.

REMARKS ON ABOVE PHENOMENON.

It seems likely that the surface tension of the liquid cloud particles near the electrically-charged kite wire is weakened and that, depending on the air temperature, evaporation or freezing of these particles results. It is probable that crystallization resulted in the two cases

observed at Mount Weather and that evaporation resulted in the case observed at Drexel. This would account for the "white streaks" in the first two cases and for the "blue streaks" in the third. These observations are based on the assumption that at Drexel, as at Mount Weather, the kite wire was in the clouds.—*Wm. R. Blair.*

THE WORLD'S AIR ROUTES AND THEIR REGULATION.

[*Reprinted from* Nature, London, June 28, 1917, 99:349-350.]

On June 20 Lord Montagu of Beaulieu, gave an interesting lecture before the Aeronautical Society of Great Britain on the world's air routes and their regulation. He pointed out how favorably placed the British Empire was in this matter, inasmuch as its many possessions were so scattered about the globe that suitable landing and halting places could be provided without the necessity of asking for concessions from other nations. Lord Montagu based his calculations on an assumed speed of 120 miles an hour, and showed that with two 5-hour periods per day the journey to India could be accomplished in four days.

Under the stage which aeroplanes have now reached, the carriage of mails and passengers to India seems quite a feasible proposition; the meteorological conditions along the tracks that might be followed, except at the British end in winter, are quite good. Crossing the Atlantic is another matter, specially from Europe to America; the shortest track, from Ireland to Newfoundland, is in the winter a region of gales, mostly from some westerly point, and if the more favorable weather that prevails farther south is sought, the distance is about doubled. Lord Montagu's suggestion is that certain levels be assigned to certain types of traffic, but it has been estimated that at any given time one-half of the earth is covered with clouds, and a pilot above a sheet of clouds can not keep his course, as there is nothing to tell him the strength and direction of the air drift to which he is exposed. It follows, therefore, that a pilot aiming at a definite place must fly low enough to see the earth at frequent intervals; in or above a cloud sheet he would have no horizon and could not rely on astronomical observations for his position. Thus the traffic to which the highest levels were assigned would be at a great disadvantage.

SECTION II—GENERAL METEOROLOGY.

NEW ENGLAND SNOWFALL.[1]

By CHARLES F. BROOKS, Ph. D.

[Dated: Yale University, New Haven, Conn., Apr. 5, 1917.]

The heavy snowfall of the winter 1915–16 in New England has occasioned renewed interest in the subject of previous snowy winters and of the factors controlling the average distribution of snowfall. In spite of the fact that the total depth of snowfall over most of New England was from 6 to more than 8 feet in that winter there have been much snowier seasons (e. g., 1716–17 and 1786–87) since the beginning of the eighteenth century. Some of the great storms of northeastern Massachusetts are interestingly recorded by Sidney Perley.[2] In the winter of 1716–17 snow accumulated to the depth of "10 to 15 feet on the level." The season of 1740–41 was not only severe in temperature but also very snowy. Two storms in one week of December, 1786, brought the depth of snow on the ground near Boston up to perhaps 6 feet if not more. In the eighteenth century there were apparently two other winters when the total snowfall in northeastern Massachusetts exceeded 6 feet,—1747–48 and 1798–99.[3] In the nineteenth century at least four winters in this region had more than 6 feet of snowfall—1801–1802, 1856–57,[4] 1873–74, and 1898–99. Furthermore, in the present century there have already been two such winters in northeastern Massachusetts, 1903–4 and 1915–16.

Thanks to Sidney Perley's compilations and to the records of the Signal Service and Weather Bureau at Boston, it has been easy to make this rough comparison of the history of snowy winters of the past two or three centuries. It would appear that the tremendous New England winters of long ago were no more numerous, and, with at least two exceptions, perhaps no more snowy than some in the present century. The extreme snowiness of 1716–17 and 1786–87 rests largely on the snowfalls of two weeks with two snowstorms each.

A real "old-fashioned snowstorm" is characteristically described as one in which roads and fences were obliterated, or communications by road blocked for days, and such that many people needed to make tunnels through the drifts to get out of their houses at the ground floor. In addition, the experiences of men lost in the snow and of vessels blown on shore are commonly mentioned. Meteorologically this means an intense coastal cyclone with a northerly gale and snow falling for a day and a half or more to an average depth exceeding 3 feet. In northeastern Massachusetts there seem to have been only 7 such storms in more than 200 years, these 7 occurring in but 5 of the 12 very snowy winters of the same period. In Boston since Signal Service records began in 1871 the measurements show no month with more than 3 feet of snowfall.

An important feature of New England snowstorms is their local character. The account of snowy winters and great snowstorms for northeastern Massachusetts does not agree with the history of snowfalls in other parts of New England. For instance, in the New Bedford region since the middle of the eighteenth century the most famous three snowstorms seem to have been those of December 26–27, 1778, December, 1786, and January 15–16, 1831.[5] In southern Connecticut the snowstorms of February, 1717, were extreme, and that of March 11–14, 1888, has left a strong impression on the people. Winslow Upton says,[6] "The great prominence given to the storm under consideration was due to the fact that the form of the precipitation was snow, and that it fell in the vicinity of New York, causing almost a complete suspension for several days of the railway traffic centering in that city." Everett Hayden[7] shows that 135 schooners and 81 other vessels were lost along the middle and north Atlantic coast of the United States during this storm. His monograph contains an excellent set of colored weather maps. Snow fell for about 2½ days and the depth in southwestern New England and eastern New York was estimated at 2½ to 4 feet on the level, the greater depths being along the Hudson and on the windward or western slope of the Berkshires, the southern Green Mountains, and in central Connecticut. Snowdrifts with a maximum depth of 15 to 40 feet were reported. (See fig. 3, map from Upton.)

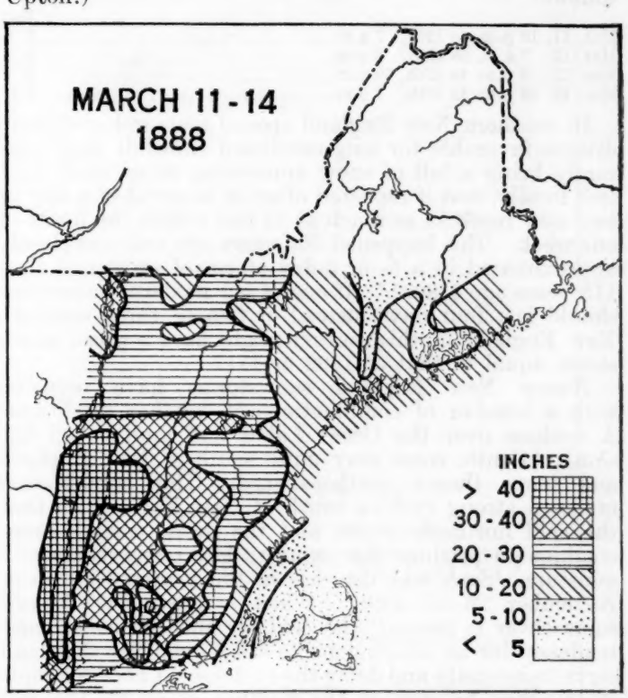

FIG. 3.—Snowfall of the storm of March 11–14, 1888 (after W. Upton, Am. metl. jour.) [Am. geogr. soc.].

On account of the local character of snowstorms, the snowfall of months and even of the individual seasons is

[1] Amplified by the author from the article under the same title in The Geographical Review, March, 1917, published by the American Geographical Society, New York, N. Y. The Weather Bureau would here acknowledge its indebtedness to the American Geographical Society, Isaiah Bowman, Director, for permission to reengrave figures 1, 3, 4, 6, 7, 9, 10, 11, 13, 14, 16, 17, 19, 20, 21, 23, 24, 26, and 30, from the original drawings prepared by that society.

[2] *Perley, Sidney.* Historic storms of New England. Salem, Mass., 1891. 341 p. 8°.

[3] *Perley*, op. cit., pp. 31–36, 51, 54, 124–125, 153.

[4] *Perley*, op. cit., pp. 161 and 323–328.

[5] See a sheet published by *Thomas R. Rodman*, New Bedford, Mass., Mar. 4, 1902.

[6] *Upton, Winslow*, Amer. met'l. jour., May, 1888, 5:19–37.

[7] U. S. Hydrographic office: Nautical Monographs, No. 5. Washington, 1888. 65 pp. 6 pl. 4°.

often quite different at places not far apart, as is illustrated by the data in Table 1.

TABLE 1.—*Seasons with more than 66 inches of snowfall measured at Boston or New Haven.*

Winter.	New Haven	Boston.
	Inches.	*Inches.*
1873-74	68.8	96.4
1880-81	69.5	53.8
1886-87	46.2	73.0
1887-88	66.2	41.2
1892-93	74.2	67.3
1896-97	67.4	43.2
1898-99	66.4	71.1
1903-04	42.7	73.1
1906-07	64.3	67.9
1915-16	[a] 76.0	[a] 79.2

[a] Since Jan. 1, 1909, regular Weather Bureau stations have measured sleet separately. Thus if sleet were included, the total for New Haven would be 82.3 instead of 76 inches.

It is evident from the scattered examples just mentioned that "old-fashioned snowstorms" are not phenomena of the past. Four feet of snow in one storm seems to be the maximum which can be expected in southern New England. Only on one occasion, February 18-22, 1717, was there apparently as much as 6 feet. From a comparison of the duration and amount of snowfall it is apparent that snow usually does not fall at a rate exceeding 1 inch an hour. Upton [8] published a table showing the rate of precipitation near the maximum area in the storm of March, 1888. At New Haven, where the snowfall was estimated at 42 inches and the equivalent depth of water content, 4.50 inches, in other words, about 10:1, the precipitation rates per hour were as follows:

	Inch
Mar. 11, 10 p.m. to 12th, 7 a.m.	0.1_0
Mar. 12, 7 a.m. to 12th, 3 p.m	0.1
Mar. 12, 3 p.m. to 12th, 10 p.m	0.1
Mar. 12, 10 p.m. to 13th, 7 a.m.	0.0_7

In southern New England special meteorological conditions favorable for long-continued snowfall may very rarely bring a fall of snow amounting to as much as 6 feet locally, and if repeated after an interval of a day or two may result in as much as 10 feet within the limits of one week. This happened 200 years ago and was closely approximated in a 5- or 6-day storm of snow and sleet 115 years ago (1802).[9] If one of our modern snowstorms should last four days instead of two or three southern New England in this century might have a great snowstorm equal to that of 1802 or 1717.

Heavy New England snowstorms have occurred with a number of combinations of weather conditions. A cyclone over the Great Lakes and another off the south Atlantic coast may unite south of New England and move thence northeastward. This combination makes a strong cyclone south of New England so that the cold northerly winds and the moist easterly ones combine to produce the requisite low temperature and moisture. Such was the case in the Portland storm of November 26-27, 1898. When a previously formed snow cover is present, the cold air and the consequent tendency for an anticyclone to stick over New England serve to intensify and delay the cyclone. A good example of this may be seen on the weather maps for the last week in March, 1916, when an anticyclone stayed over snow-covered New England, delaying and forcing to the south a cyclone approaching from the west.[10] Blue Hill Observatory records [11] show that, in general the greater the number of days with snow on the ground in a winter month (December to March) the lower is the temperature relative to the mean. Furthermore, in months with long-enduring snow cover, there are the greatest inversions of temperature between the top of the hill and the valley station 600 feet below. With an average depth of 26 inches of snow on the ground on February 15, 1899, simultaneous temperatures at the top of the hill and in the valley were 8°F. and −20°, respectively, the greatest difference recorded there up to that time. [12] [13]

The other common type of cyclonic arrangement favoring New England's northeast snowstorms involves a single cyclone which fights its way up the coast against the southward circulation on the east side of a great anticyclone lying dormant over the intensely cold, snow-covered ground. The snowstorms of January 18–19, 1857, and February 11–14, 1899, are examples.[14] In addition, any combination which results in the passage of a strong cyclone immediately south of, or northward through, New England, while an anticyclone on the northeast or north is in the way, favors the occurrence of heavy snowfall if the temperature is low enough. In March, 1888, an anticyclone following the passage of a cyclone north of New England, entered New England on the west just as a southern low center was approaching the south shore. The difference in temperature, which at one time was 25 degrees F. in 75 miles, favored the development of a strong cyclone, while the wind circulation and southeastward tendency of the anticyclone prevented the normal northeastward movement of the cyclone.

Snowy winters, while sometimes taking their character from a single storm, are generally the result of the passage of a number of cyclones south of or through New England. Cold winters are more snowy in southern than in northern New England, while warm winters may lead to excessive snowfall in northern New England by reason of greater moisture in the air (compare 1915–16 with 1900–1901, as shown in figs. 24 and 26 on pp. 282, 283). As the winter 1915–16 was, for southern New England in general, the snowiest in more than 40 years, and was exceeded over a wide area perhaps only twice in two centuries, the meteorological conditions producing it may give some indication as to the immediate cause of such snowy winters. In the three snowy months, December, February, and March, the North Atlantic cyclone was stronger than usual, particularly so in the very snowy March.[15] In the summers of 1915 and 1916 the ice in the Greenland Sea was abnormally extensive.[16] Also, in the summers of 1786 and 1787 the ice off the east coast of Greenland was so extensive that at 65° N. latitude Danish ships could not approach closer than 50 miles to the coast in July or 10 miles in August, 1786, while the closest approach in

[8] Amer. met'l. jour., 1888, 5:36.

[9] *Perley*, op. cit., p. 161.

[10] "Weather forecasting in the United States" (W. B. No. 583, 1916), pp. 107, 133, 139. *See also Köppen, W.* Verhältniss von Frost, Schneedecke, etc., im Winter 1906-07. Meteorol. Ztschr., 1907, 24: 323-325.

[11] Annals, Astron. obs'y. Harvard College, Cambridge, ...

[12] These results from Blue Hill data were obtained largely by the class in climatology at Yale College in 1916.

[13] *Vorikov* has fully discussed the effect of a snow-cover, in his paper "Der Einfluss einer Schneedecke auf Boden, Klima und Wetter," Wien, 1889 (Penck's Geogr. Abhdl., v. 3, no. 3) which was reviewed in the Amer. met'l. jour., 1890, 7:332-336.

A more recent paper on the subject is by *O. V. Johansson*, Dämpfende Wirkungen des Schnee und Eises auf die Lufttemperatur. Öfversigt, Finska Vetensk. Soc. Forh., Aft. A, 1912-13, 60, no. 11. 64 p.

[14] Maps of isobars and isotherms for Feb. 12, 13, 14, 1899, are published in "Weather forecasting in the United States" (W. B. No. 583) as figs. 114, 115, 116.

Maps of the snowfall day by day for that period are published in this REVIEW, June, 1914, 42: 319-324 as figs. 1 to 6, inclusive, illustrating *C. F. Brooks* "Distribution of snowfall in cyclones of the eastern United States," ibid.

The weather map for a type of heavy snow over southern New England is illustrated by that for Dec. 22, 1908. (See fig. 163 of "Weather forecasting," supra.)

[15] *Brooks, C. F.* World-wide changes of temperature. Geograph. review, New York, Oct. 1916, 2: 249-255.

The temperature of the Gulf Stream water southeast of Nantucket was about 2 degrees (F.) above normal in March, 1916.

[16] *See* Spitsbergen ice conditions, 1915 and 1916. *C. I. H. Speerschneider* in Denmark, Meteorologisk aarbog, 1916. Nature, London, Feb. 8, 1917, pp. 454-455; *also* Geographical review, New York, Oct. 1916, 2: 307, 310.

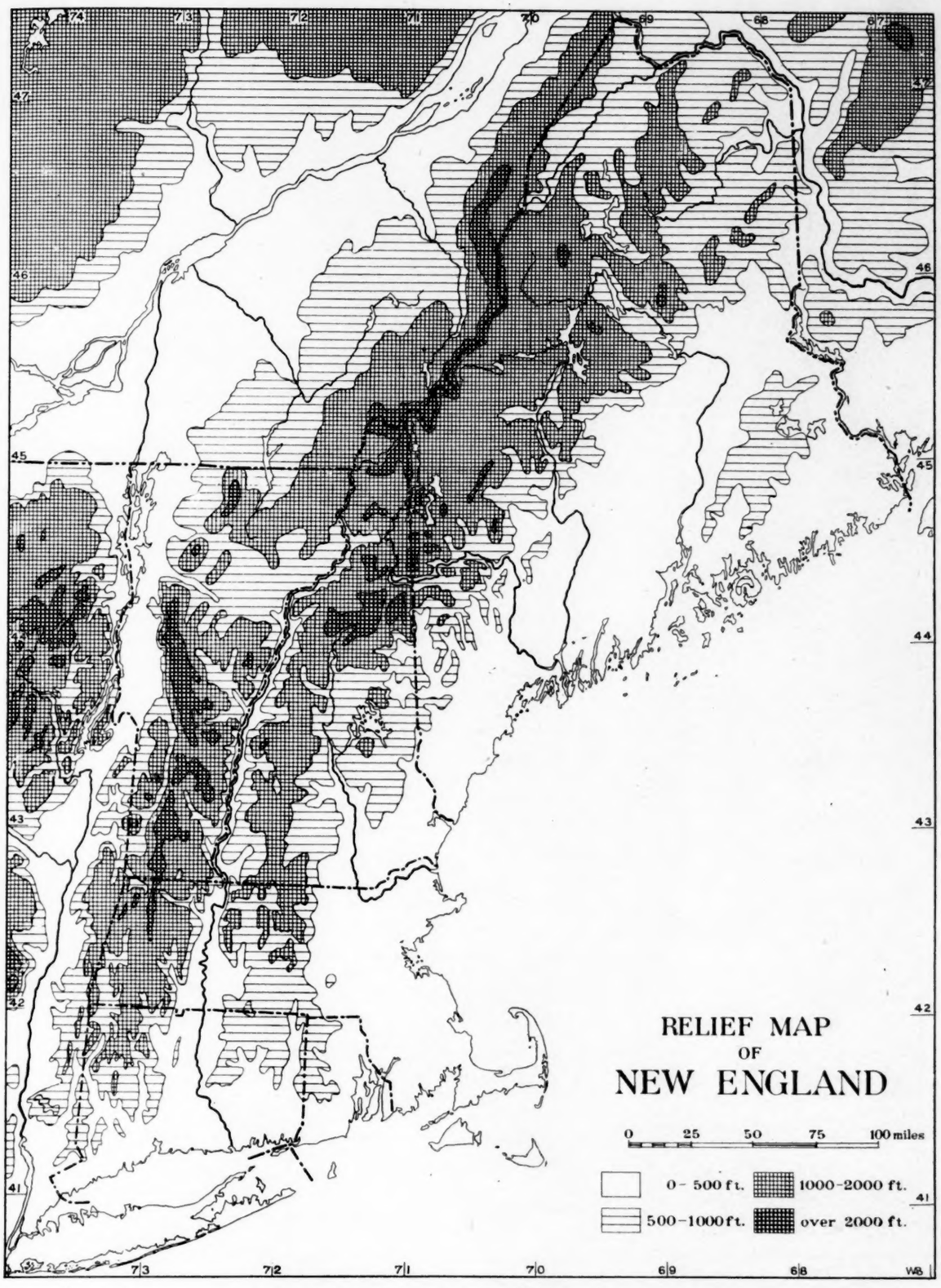

FIG. 1.—Relief map of New England. Scale, 1:3,500,000. [Am. geogr. soc.]

In New England the contours are based on the current edition of the U. S. Geological Survey contour map of the United States, 1:2,500,000: in Canada, on J. G. Bartholomew's Orographical Map of the St. Lawrence Basin, 1:5,000,000, accompanying S. E. Dawson's "The St. Lawrence Basin and Its Borderlands," London, 1905.

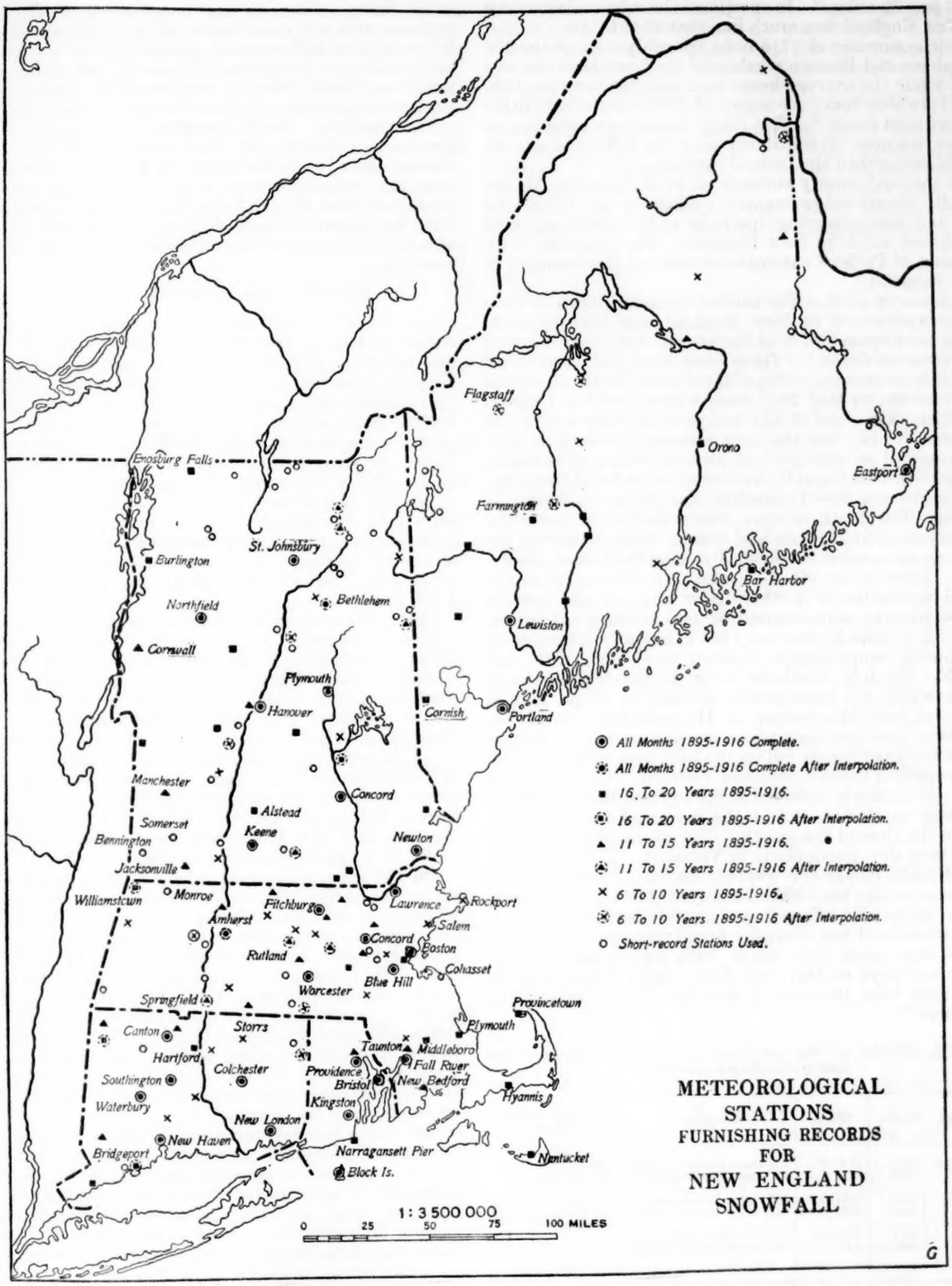

FIG. 2.—Map of New England showing location of stations and characters of the respective records used in preparing figs. 3-30, inclusive.

1787 was 30 miles.[17] In snowiness the intervening winter in New England was much like that of 1915–16.

In the summer of 1716 none (possibly one) of the 153 Hamburg and Bremen whalers in the Greenland Sea was lost, while the average losses each summer between 1697 and 1719 were four; the season of 1700 was the only other one without losses.[18] This might indicate an open season whose warmth, if continued into the following winter, would strengthen the Iceland cyclone.

In the cold, snowy summer of 1816 there was an unusually strong subpermanent cyclone in the Greenland Sea and accompanying (perhaps only coincident) cold northwest winds in New England. The following is an abstract of Perley's extensive account of that summer in New England.[19]

Summer of 1816.—The coldest summer known to have been experienced in New England was that of 1816. Some have spoken of it as the year of "eighteen hundred and froze to death." There were frost and snow in all the summer months. Near Manchester, N. H., there was an ice storm on May 24. Snow was reported in Ohio on the 22d. On June 5 the temperature rose to 88° at Chester, N. H., but the next morning ice formed to a thickness of an eighth of an inch on bodies of standing water. In a cold squally west wind, snow fell in Vermont, Massachusetts, New Hampshire, and Maine on June 6, 7, and 8. The depth of snow was sufficient to cover the ground even at Newton and Salem, Mass., while in the western mountains it collected to depths of more than a foot. Frost on the 9th, 10th, and 11th of the same month killed vegetation in northern New England and western Massachusetts, and occurred on two mornings at Salem. June 22, 23, and 24 were very hot in Salem, the successive maximum temperatures reported being 93°, 101°, and 100°F. In July northern New England experienced frosts which did considerable damage to crops, and at Amherst, near Manchester, N. H., snow fell. In Massachusetts, however, July was a warm month. In August there was frost; snow fell on the hills west of Manchester and whitened the mountains in Vermont. On September 11, 2 or 3 inches of snow fell at Springfield, Mass., followed by snow at Boston and at the mouth of the Kennebec before the close of the month. The season as a whole had been very dry, particularly in Vermont. In Connecticut and Rhode Island the weather had not been extreme. The season was somewhat backward, but the crops were not so materially affected as they were farther north.

In Greenland Sea Scoresby found this summer of 1816 to be more open than usual, with higher temperature, more wet days in May and June, and a lower pressure than had been the case in any but one or two of ten summers.[20]

TABLE 2.—*Weather of May and June, 1916, in North Greenland Sea west of Spitsbergen (Scoresby).*

Element.	Month.	Means.	Departures.	Relation to other extremes.
Temperature.	May....	24.6° F....	1.8° above 12-year average...	1808 and 1817 warmer.
	June...	33.9° F....	2.6° above 10-year average...	1813 warmer.
Pressure....	May....	29.84 inches	0.07" below 12-year average..	1808 and 1813 lower.
	June...	29.81 inches	0.06" below 10-year average..	No other June so low, 1809–1818.
Winds.....	May....	SE. to S..	Winds usually north in May.	
	June...	SW.....	Winds usually north in June.	

[17] *Scoresby, William, jr.* Account of the arctic regions, etc. ——. 1820. v. 1, pp. 3, 69.
[18] *Zordrager, C. G.* Grönländische Fischerei und Wallfischfang. Leipzig, 1723. pp. 370, 376.
[19] *Perley.* Historic storms, etc., pp. 204–213.
[20] *Scoresby, William, jr.* op. cit., vol. 1, app. 1.

As sharp contrasts in temperature make strong cyclones, it is not inconsistent to say that both excessive ice conditions and unusual openness of the waters north of Iceland may bring about or accompany intense "Iceland" or North Atlantic subpermanent cyclones, for a strong temperature gradient occurs somewhere under either condition. Such a gradient may be produced over the western Atlantic by abnormal warmth of the Gulf Stream there, as in the winter of 1915–16. These citations are mere suggestions as to the way in which snowy winters of New England may be explained and perhaps later forecasted. Obviously the proof awaits the study of a series of years' observations of Northern Hemisphere weather.

MONTHLY AND SEASONAL SNOWFALLS.

In spite of its small area the snowfall of New England differs greatly in different parts, such inequalities being due primarily to latitude, altitude, and exposure. New England snowfall may be considered in two divisions: The western and northern mountainous section, and the lower coastal region. In the mountains the greater the altitude the heavier is the snowfall, as a general rule. While the temperature control of latitude and altitude on snowfall is important, the exposure to snow-bringing winds and the proximity of water surfaces to windward cannot be overlooked. For example, the Green Mountains become progressively snowier southward on account of more open exposure to moist easterly winds from the Atlantic.[21] (See discussion of fig. 15, map for February, 1899, p. 278–9.)

Heavy snowfall on one side of a range of mountains or hills is accompanied by light snowfall on the other side, for any winds after losing moisture on one side arrive as warming drier winds on the other. Mountains cast shadows in the sunlight, and just as truly they cast "snow shadows" in the snow-bearing winds. The Champlain Valley is in the "snow shadows" of both the Green Mountains and the Adirondacks, and so is a region of relatively small snowfall. The least snowfall in Vermont, except in the extreme southwest, occurs at Burlington behind the highest part of the Adirondacks on the west and the White and Green Mountains on the east. The upper Connecticut Valley is similarly affected.

On the immediate coast winds blowing freely off the ocean are chilled and made to yield up some of their moisture as they lose velocity and rise over the land. If the wind is previously at a temperature just below freezing it may swirl onto the land in clouds of dense snow. In general, it is cold enough for snowy ocean winds only in February, March, and April.[22] Inland a little way, if the land were flat, a belt of maximum snowfall would soon be reached, for it is here that the wind behind is most crowding against and piling over the lower wind, which is retarded by friction. Perhaps this is why Hyannis has more snowfall than Rockport, Provincetown, and Nantucket.

Where for some distance inland the country is rising, the zone of maximum snowfall is farther from the shore and the snowfall is more intense because of the heavy precipitation produced at lower temperatures. Such is the case some 40 miles inland in western Maine and eastern Massachusetts. Beyond the crests of the divide the snowfall decreases somewhat, but not so rapidly as

[21] Evidences of local glaciation on the east side of the Green Mountains in southern Vermont were described by G. D. Hubbard at December, 1916, meeting of Assoc. Amer. Geographers. Ann., Assoc. Amer. Geogr., 1916, 6. Cf. Wilmington, Vt., topog. sheet, U. S. Geol. Surv.
[22] *Brooks, C. F.* Snowfall of the eastern United States. MO'LY WEATH. REV., Jan. 1915, 43: pp. 5, 9, and 10; figs. 4, 6, 8, and 10, on pp. 6 and 7.

toward the warm ocean. Thus, in south central Maine, the upper Merrimac Valley, the lower Connecticut Valley, and eastern Rhode Island, the snowfall is appreciably less than in the but slightly higher region on the east. Other factors which lead to the decreased snowfall of inland valleys are the weaker cyclonic action and the usual higher temperatures at the lower elevations.

Some snowfall comes with westerly winds, thus at times reversing the side of the divide on which snow is at its maximum. The snowfall distribution of coastal New England is not unlike that of the mountains. In this case, the immediate shore, even when flat, has somewhat the effect of a range of hills—when the temperature is low enough the snowfall near the shore is heavy, and snow-shadow areas are developed behind, especially in the valleys.

DATA.

In preparing the accompanying maps, all the readily available published snowfall data for the period 1895–1916 were used. These data were taken from the monthly reports of the New England weather service, the MONTHLY WEATHER REVIEW, and the monthly report "Climatological Data for the New England Section." The maps of average snowfall are based on the records from 178 stations, many of the short-period records being combined, when close together, or used to fill in deficiencies of the longer records from near-by stations. Of course, the foundations for the lines were the 29 complete records of the 21 seasons. Other records were divided into the three groups designated on the base map (fig. 2): 16 to 20 years, 11 to 15, and 6 to 10. A few records of less than six years were used on the basis of ratios derived from the longer records of near-by stations having the same general exposure.

TABLE 3.—*Extent of snowfall data, 1895–1916 (see fig. 2).*

States.	All stations with any reports.	Number used in making averages.	Averages put on map of seasonal snowfall (fig. 30).				
			21 years.	16–20 years.	11–15 years.	6–10 years.	Total.
Maine	47	32	3	9	2	4	18
Coordinated*					1	4	5
New Hampshire	38	31	5	5	0	3	13
Coordinated			1	1	3	1	6
Vermont	31	27	2	5	3	2	12
Coordinated					1	1	2
Massachusetts	93	58	7	7	8	10	32
Coordinated			1	2	3	2	8
Rhode Island	8	7	4	1	1	0	6
Connecticut	28	23	6	2	3	4	15
Coordinated				2		1	3
Total	245	178	29	34	25	32	120

*The coordinated records are those pieced together from two or more neighboring stations.

This table shows the minimum available for all the months; for each month the data are more extensive. They appear sufficient to allow a fairly accurate mapping of the distribution of snowfall. The addition of three years of records and of the short ones for filling has changed the aspect of the average snowfall shown on the maps already published; but the alterations are in details, and follow the principles indicated by the earlier maps.[23] These features stand out all the more clearly with the removal of some of the minor irregularities due to shortness of period and lack of stations. The errors of snowfall measurement are so great at times that it is only the accordance of results at stations similarly located which justifies making maps of "snowfall."[24] The probable error of these averages from the true mean (if there were such a thing) is large. For instance, as computed by Fechner's formula, $E=\frac{1.1955}{(2n-1)^{\frac{1}{2}}}\times v$, where v is the mean departure from the average and n the number of years, the probable error, E, of the 21-year seasonal average at Eastport, Me., is 4 per cent, and that at Enosburg Falls, Vt., 5 per cent.[25] In spite of these errors the following maps consistently uphold one another in illustrating the broad principles already mentioned.

THE MAPS.

For the months May to October, inclusive, no maps are published here, for except in the mountains the snowfall of these months is negligible. Snowfall in May is nowhere a rarity except on Cape Cod, where none has been observed in at least 21 years. In June, July, and August, 1816,[26] snow fell in New England and even on the coast of Massachusetts. There have been occasional snows in these months on the mountains since then. September snow is common in the north and not very rare south even to the central highlands of Massachusetts. In October during the past 21 years snow has fallen throughout New England. Average amounts in excess of 1 inch are encountered in the White Mountains, and on the east flank of the Green Mountains.

November snowfalls.

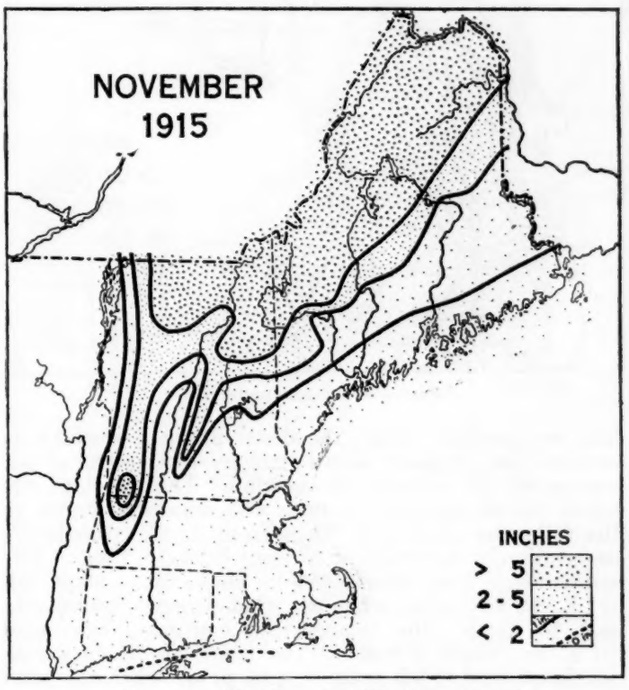

FIG. 4.—Snowfall of November, 1915. [Am. geogr. soc.]

November, 1915 (fig. 4).—The only snowstorm of importance was brought by a cyclone passing through New England. Thus there was appreciable snowfall only in the north; and the limits of this fall are rather sharply

[23] *Brooks, C. F.* MONTHLY WEATHER REVIEW, January, 1915, 43: 6-10 and Charts 19-22. Figs. 3, 5, 7, 9, 11, 12, and 14.

[24] *Brooks, C. F.* In MONTHLY WEATHER REVIEW, January 1915, 43: 2-4.

[25] *Hann, J. von.* Lehrbuch der Meteorologie, 3d ed. Leipzig, 1915, p. 112, or Poggendorff's Annalen der Physik, Jubelband 1874, p. 61.

[26] *Perley, Sidney.* Historic storms, etc., pp. 204-213.

defined. Light snows occurred on two other occasions. Throughout New England the snowfall was less than the average. In a similar way the snowfall of February 21–24, 1912, in the eastern United States shows a remarkably sharp line of demarcation between the heavy snowfall north of the cyclone track and the light snow on the south side.[27]

November, 1898 (*fig. 5*).—Most of the snowfall came on the 26th and 27th, during the "Portland storm." This was a very intense cyclone formed by the junction south of New England of a low-pressure area from the Great Lakes with one on the Atlantic coast. The heaviest snowfall of the month occurred in southern Connecticut, far enough west to be little affected by the warmth of the Atlantic, yet close enough to the cyclone center to have very heavy precipitation. The slight height of land in southeastern Massachusetts was sufficient to provoke

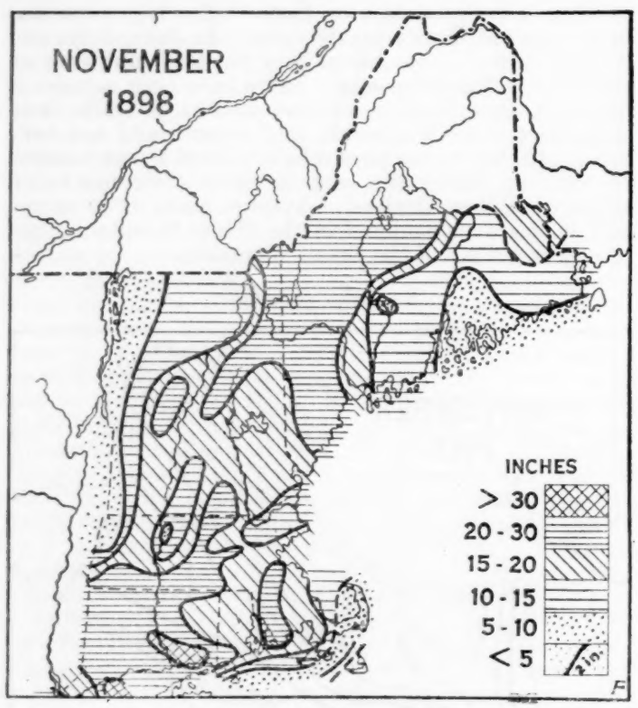

FIG. 5.—Snowfall of November, 1898.

heavier snowfall. Also, the distribution of snowfall in central New England shows strongly the control of exposure on the amount of snowfall. The effect of the ocean on temperature early in the season is shown in the following quotation taken from A. E. Sweetland's description of the storm of November 26–27, 1898: "The temperature line (thermograph) shows an abrupt fall (7° F.) at 2:10 a. m., when the wind changed from northeast to north; the temperature continued low until 10 a. m., when it rose as the wind veered to north-northeast, and it fell again at 4:05 p. m., when the wind changed to north-northwest." [28]

November mean snowfall, 1895–1915 (*fig. 6*).—November is characterized by small coastal amounts, as is the case with the two months just discussed.

[27] *Brooks, C. F., in* MONTHLY WEATHER REVIEW, June, 1914, 42: 325–330, maps of daily snowfall and discussion.
[28] *See* Bull., Blue Hill met'l obs'y, 1899, No. 2.

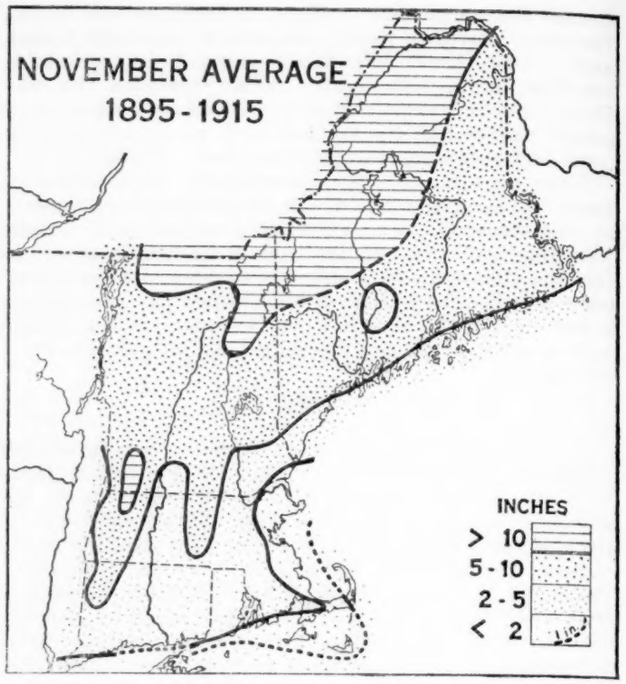

FIG. 6.—Mean snowfall in November, for 1895–1915. [Am. geogr. soc.]

December snowfalls.

December, 1915 (*fig. 7*).—Most of the December, 1915, cyclones with snow passed through New England, many of them entering from the south. The storm of December 13 was the most important, the depth of snowfall ranging from a foot and a half in western Massachusetts

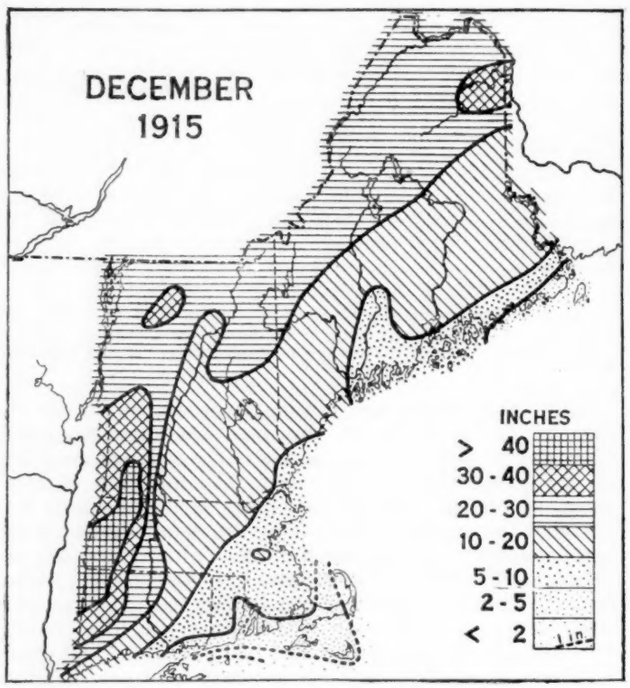

FIG. 7.—Snowfall of December, 1915. [Am. geogr. soc.]

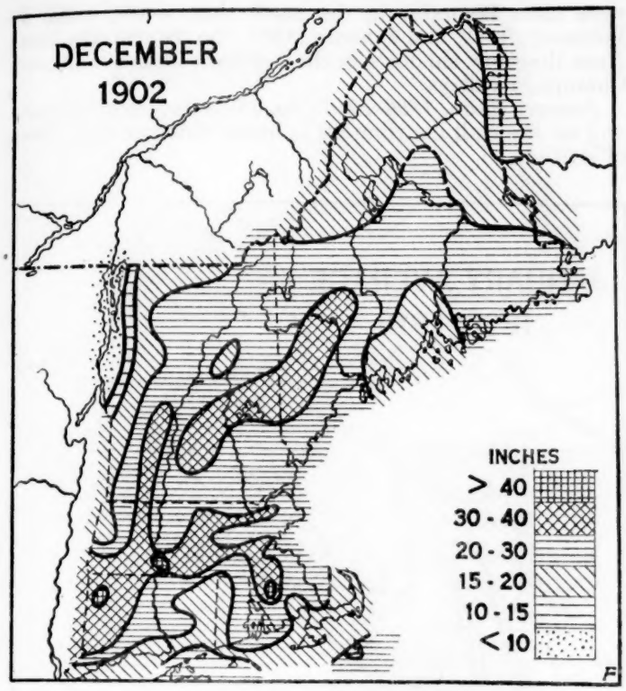

FIG. 8.—Snowfall of December, 1902.

and a foot at Springfield to less than an inch at Boston. In the south the heavy snow was very dense (density = 0.23, New Haven) and caused great damage to wires and trees; farther north, although the depth of snowfall was greater, the water content was less. The greatest amount of snow considered from the point of its water content is, therefore, not coincident with the greatest depth of snow on the ground. Similarly, the snowfall of March 11–14, 1888, had a density exceeding 0.2 on the immediate coast in the south, but the usual 0.1 in the interior.[29] As warm winds prevailed in eastern New England on December 13, 1915, the snowfall there was confined to the closing flurry of the storm.

December, 1902 (*fig. 8*).—In December, 1902, two cyclones with widespread snowfall passed, one south of, and the other across, New England. The effect of the warmth of the ocean is to be seen in the reduced snowfall all along the coast; and the diminution of cyclonic strength inland probably explains the well-defined northern limit of snowfall in excess of 30 inches in Vermont, New Hampshire, and Maine.

December mean, 1895–1915 (*fig. 9*).—As indicated by the maps for preceding months, the December snowfall lines still tend to run parallel to the coast.

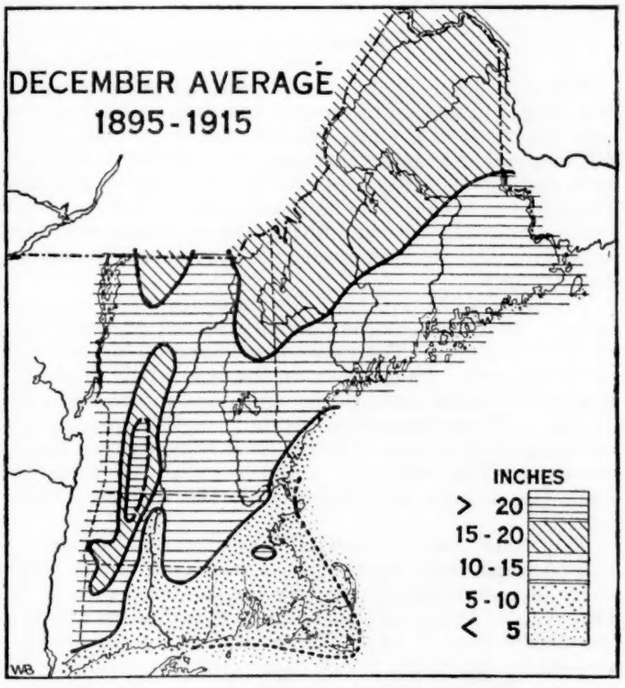

FIG. 9.—Mean snowfall in December, for 1895–1915. [Am. geogr. soc.]

January snowfalls.

January, 1916 (*fig. 10*).—All the snowy cyclones of this month passed on the north. On this account only in the north did snow occur in average amounts, as southerly winds do not favor snowfall. In the south at many places this January was one of the two or three least snowy Januarys in the 21 years.

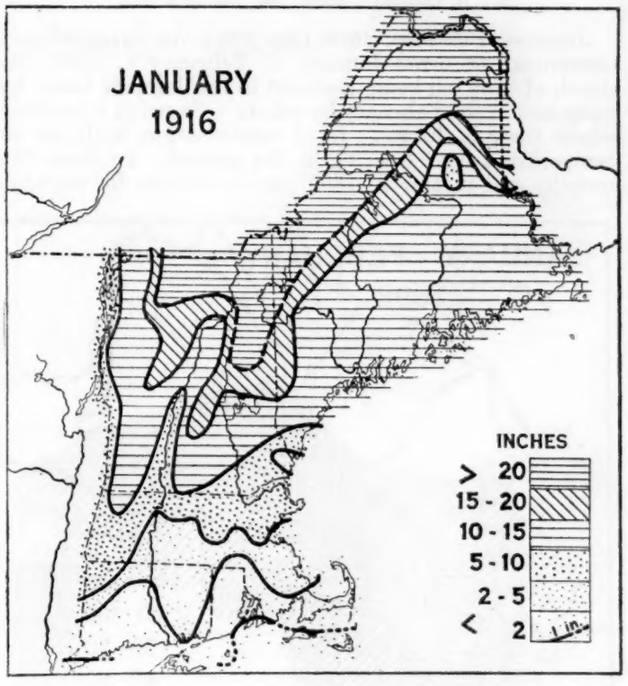

FIG. 10.—Snowfall of January, 1916. [Am. geogr. soc.]

January, 1904 (*fig. 11*).—On the 2d to 3d a cyclone accompanied by a very intense snowstorm passed south of New England. As with other single storms the snowfall was extreme only in part of New England. (See discussion of fig. 28, p. 283–4.)

[29] Winslow Upton *in* Amer. met'l jour., May, 1888, 5: 35, discusses variations in the density of the snow at different points in this one storm.

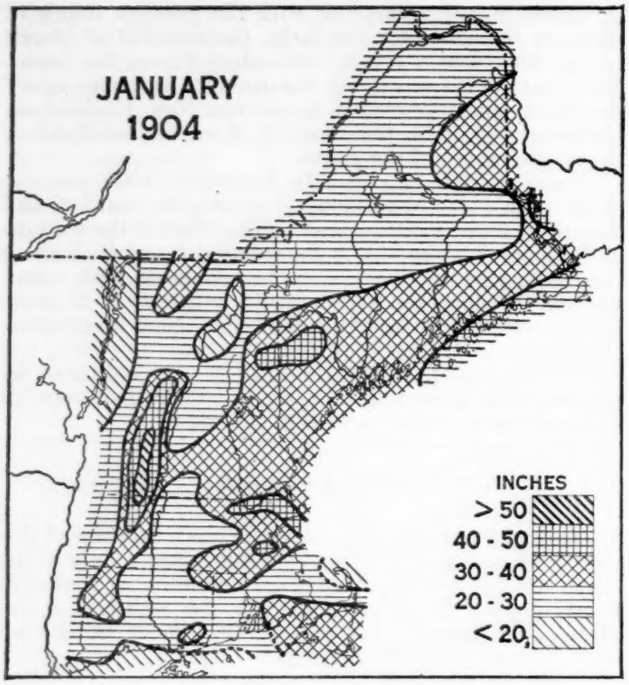

FIG. 11.—Snowfall of January, 1904. [Am. geogr. soc.]

January–February, 1898 (*fig. 12*).—An extraordinary snowstorm occurred January 31–February 1, 1898; the depth of snowfall being included in the January totals by some and in the February by others. Snowfall is heaviest where there is the most rapid condensation, with the air temperature near freezing at the ground. In these two months and in March, 1899, the conditions for snowfall were more favorable in the north than south, while in February, 1899, and January, 1904, the reverse was true. Note the snow shadows in the northern Connecticut and Champlain valleys.

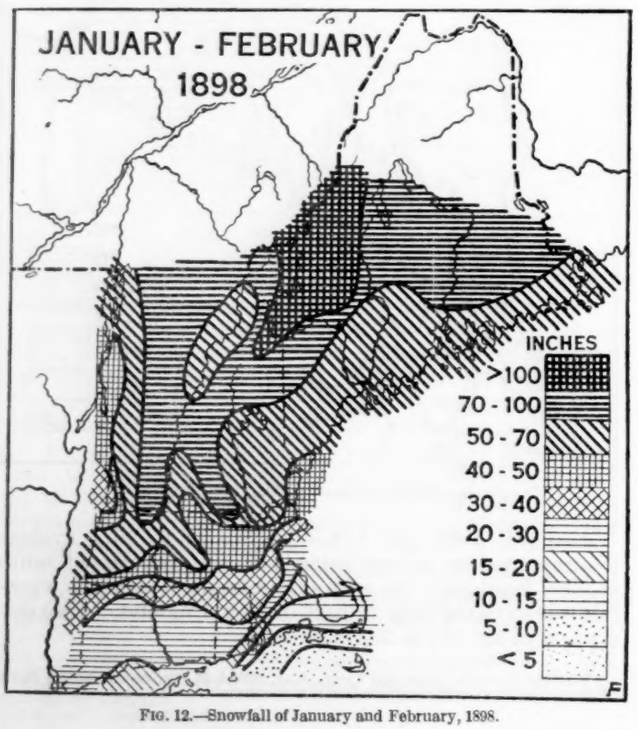

FIG. 12.—Snowfall of January and February, 1898.

January mean, 1896–1916 (*fig. 13*).—Topographic control on snowfall distribution is much stronger than that of latitude.

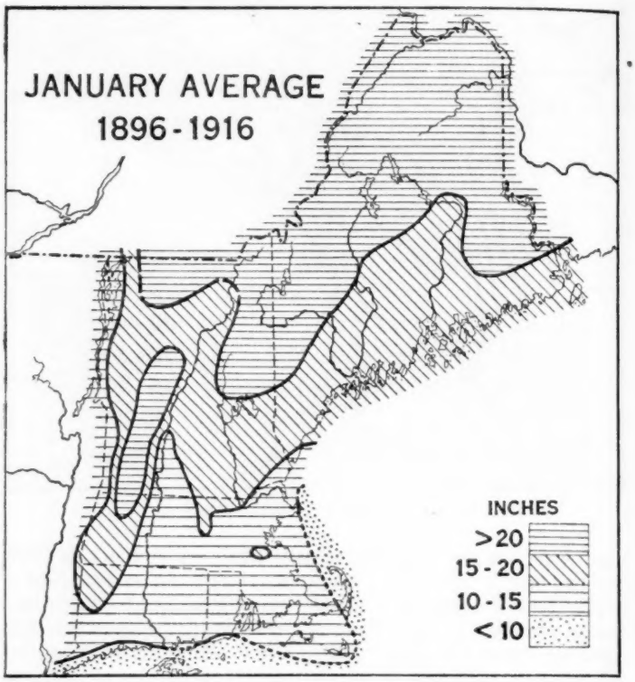

FIG. 13.—Mean snowfall in January, for 1896–1916. [Am. geogr. soc.]

February snowfalls.

February, 1916 (*fig. 14*).—As the storms passed through New England and on the south, and as the month was so cold that little of the precipitation fell as rain, the snowfall was rather evenly distributed throughout the region, with but little differences due to latitude or altitude. The effect of the ocean is apparent only in that there was much snowfall; snow-inhibiting temperatures were not experienced on the east coast as in November, December, and January.

February, 1899 (*fig. 15*).—Two moderate and one very intense snowstorm accompanied cyclones passing south of New England. The extreme coldness of the first half of this month, when most of the snow fell, made the heaviest snowfall come in the south and in the lower elevations. Thus topography is but slightly represented except in such regions of low relief as southeastern Massachusetts. The relatively small snowfall of Enosburg Falls (18 inches) and Jacksonville (25 inches) is noteworthy.

The usual heavy snowfall in southern Vermont is caused apparently by the passage of cool, moist winds over the mountains, favored by the eastward turn of the Connecticut Valley at that point, which hinders a farther southward flow of air. This ascent of the air leads to cooling by expansion which causes the increased precipitation. Table 4 brings out this effect. Brattleboro is freely exposed to the northeast winds sweeping down the

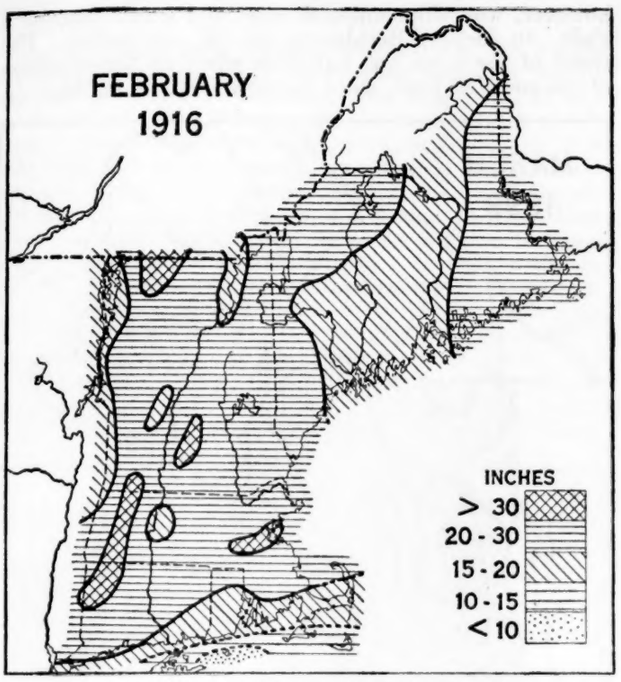

FIG. 14.—Snowfall of February, 1916. [Am. geogr. soc.]

river and is located at the turn. Jacksonville is on the highlands on the west, but east of the divide. In very snowy (January and February, 1898) or very cold months (February, 1899) snowfall at Brattleboro may equal or even exceed that of Jacksonville. Vernon is around the bend of the river and so its snowfall is considerably less.

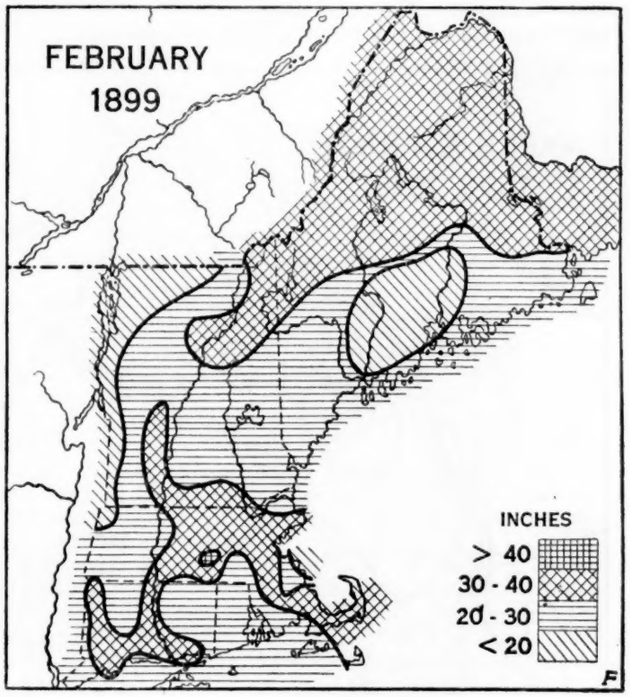

FIG. 15.—Snowfall of February, 1899.

Higher than Jacksonville the snowfall is apparently heaviest. Monroe, Mass., on Hoosac Mountain, and Somerset, Vt., west of Jacksonville, have too short records to prove this.

TABLE 4.—*Altitude, exposure, and snowfall (to nearest inch) in southern Vermont.*

Locality.	Altitude above sea level.	Average 1896–1900.	January and February, 1898.	February, 1899.	Season.	
					1895–96.	1915–16.
	Feet.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
Brattleboro	335	97	78	35	79	.....
Jacksonville	1,000	106	74	25	113	.....
Vernon	310	76	62	30	60	86
Monroe	1,860	.....	.....	.....	126	.....
Somerset	2,096	.....	.....	.....	.....	161
Williamstown, Mass	711	.....	(*)	20	41	119

* Bennington had 38 inches.

In northern New England west-wind snowfall is encountered in large amounts where winds from the St. Lawrence Valley rise to cross the mountains, as, for instance, at Enosburg Falls, Vt., with an average seasonal snowfall of 97 inches, and at Bethlehem, N. H., with 85 inches. In February, 1899, there was too little moisture in the air to allow the usual excess of snowfall in these places.

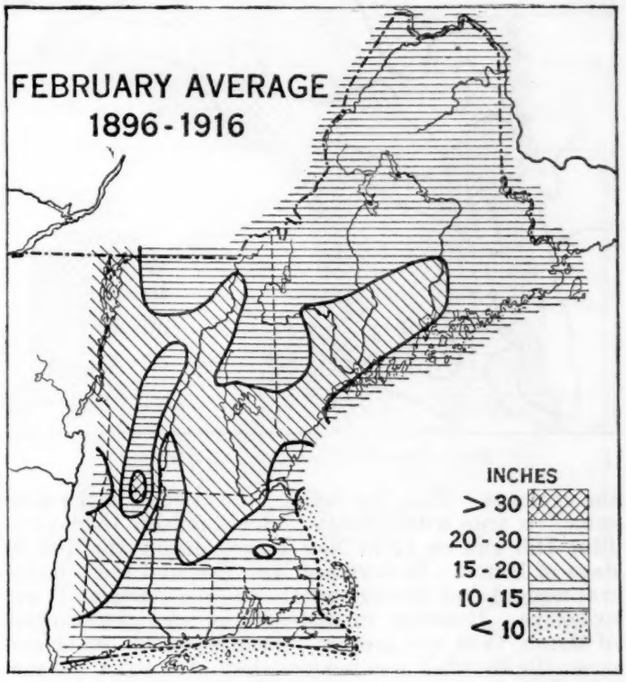

FIG. 16.—Mean snowfall of February, for 1896–1916. [Am. geogr. soc.]

February mean, 1896–1916 (fig. 16).—The ocean being cold by February it is possible for heavy snowfall to occur on the coast, especially in Maine. This is the month of maximum snowfall throughout New England. Nowhere is the winter generally so cold that there is a midwinter reduction in snowfall due to the reduced moisture capacity of cold air. There is a suggestion of such an effect in Vermont, where at most stations the heaviest snowfall in any month has come in March (see February, 1899).

March snowfalls.

March, 1916 (fig. 17).—Except in the southeast New England was entirely snow-covered from early February to the end of March, 1916. At New Haven the ground was more than half covered from February 3 to March 28 and for the whole season more than half covered with snow on 91 days. On March 21 the depth of snow in eastern Massachusetts exceeded 20 inches and in the western part and New York averaged 3 feet, with drifts reported as high as 15 feet. As mentioned on page 272, the low temperatures (Blue Hill, Mass., temperature Mar. 1–21 was 11.1 degrees below normal) favored by this snow cover tended to aid the development of anticyclones and so to make approaching cyclones pass south of New England. Furthermore, the marked warmth of the near-by portion of the Gulf Stream tended to strengthen

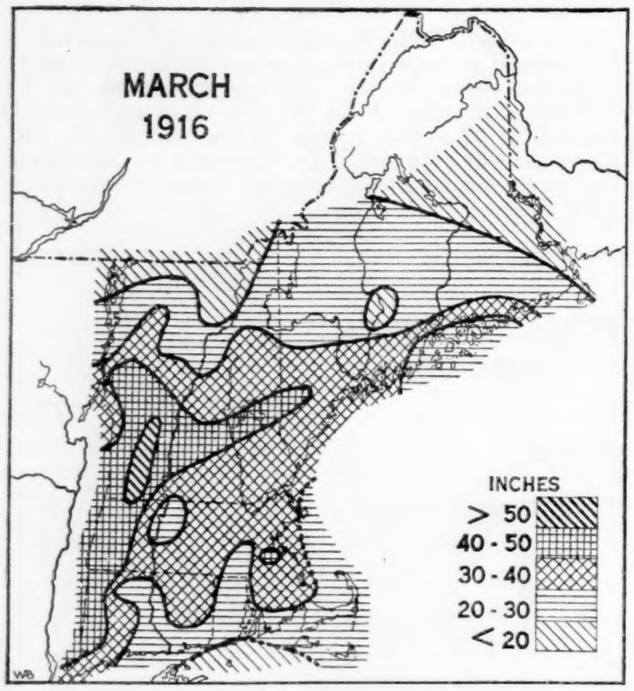

FIG. 17.—Snowfall of March, 1916. [Am. geogr. soc.]

the cyclones. Thus the saying "the more snow the more snow" is true within limits. Snow fell on 16 days at Blue Hill and on 12 in New Haven during the first 21 days of March. In northern New England the snowfall was normal, but throughout the southern portion it was excessive. However, in some of the area the snowfall of March, 1888, was greater. At most points on the east coast the snowfall was heavier than at a short distance inland, as is to be expected in March. The extremes of the western mountains were due to the topographically enforced rise of the moist air. As in February, most of the precipitation of the month was in the form of snow, hence there was more snowfall in southern New England than in northern because of the greater supply of moisture.

March, 1899 (fig. 18).—A moderate snowstorm accompanied the passage of a cyclone north of New England; two heavy snowstorms came with cyclones on the south, and one heavy snowstorm was brought by a cyclone passing through New England. In the north the usual heavy snowfall on the east of the divides and the lighter snow on the west is apparent. In the extreme north, however, west-slope snowfall was very great: Enosburg Falls, 49 inches; Bethlehem, N. H., 46 inches. The trend of the coast has but little effect on the direction of the snowfall lines, since the ocean is cold in March.

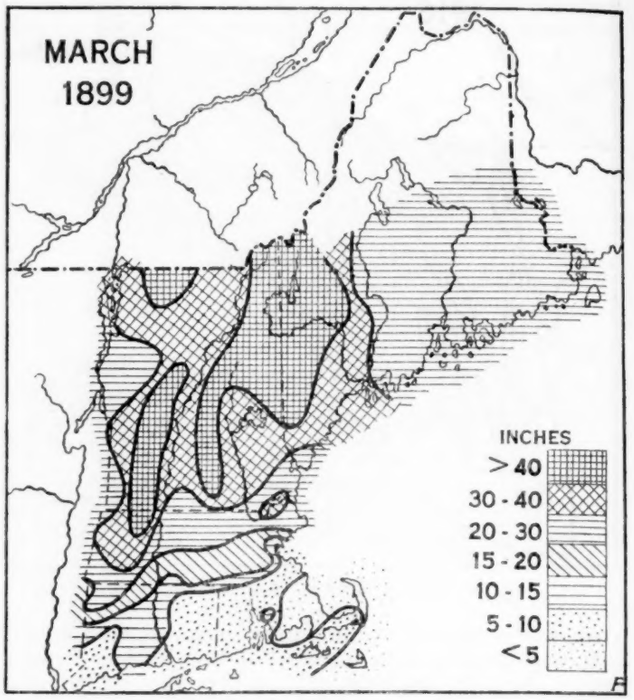

FIG. 18.—Snowfall of March, 1899.

March mean, 1896–1916 (fig. 19).—The snowfall is almost the same as that of December, except on the coast of Maine. The coast snowfall in March is heavier relative to that of the interior than in December.

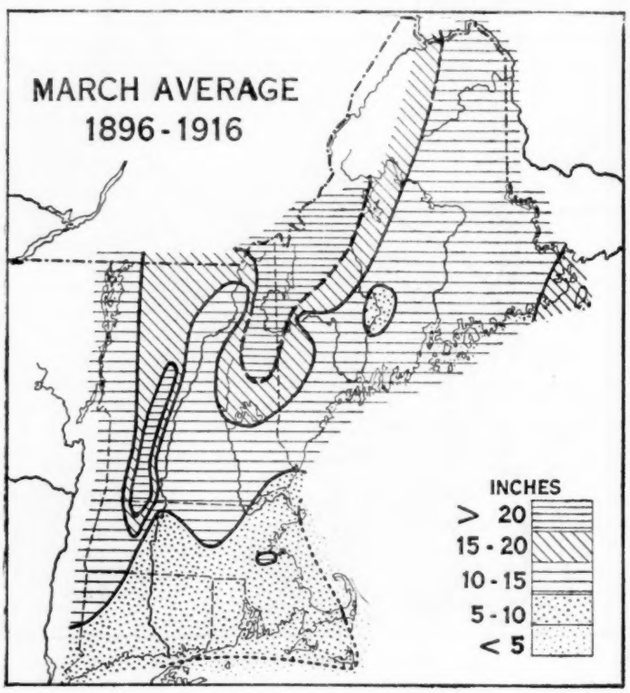

FIG. 19.—Mean snowfall of March, for 1896–1916. [Am. geogr. soc.]

Maximum snowfall in any month.

The maximum snowfall in any month (fig. 20) equals about half the snowfall of the snowiest season in southern, and one-third in northern, New England. In the north, January and March were the months with maximum snowfall, February being third; in the south, this order was February, January, and March; and for New England as a whole, January, February, and March. Although 21 years is too short a period to give these extremes much weight, they seem to indicate to some extent the effect of February cold. In the north, on account of the reduced moisture capacity of the atmosphere it apparently can not snow so hard in February as in January or March, even though the highest mean is in February. In the south, where it is usually too warm for much snow, the month of greatest snowfall comes late in winter when temperatures accompanying "northeast storms" are most likely to be below freezing.

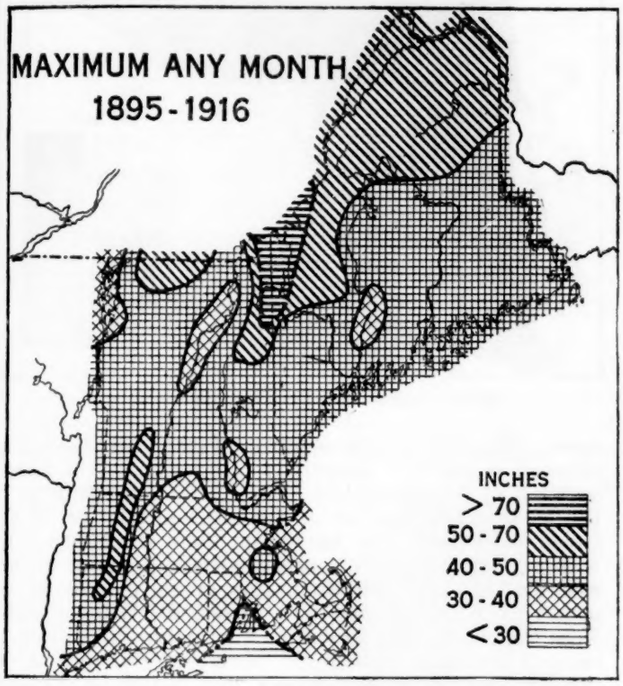

FIG. 20.—Maximum snowfall in any month, for 1895–1916. [Am. geogr. soc.]

April snowfalls.

April, 1916 (fig. 21).—Since the snow cover of March lasted into April in northern New England, the same condition of southern cyclones was favored. As was to be expected, the snowfall of the extreme northwest was but little above the average. The east coast snowstorm of April 28 was extraordinary for so late in the season. On Blue Hill the 8 inches of dense snow (water content, 1.68 inches) lasted till noon the 29th, on which day the temperature reached 61°.

April, 1907 (fig. 22).—At the close of a decidedly snowy winter an intense cyclone lingered for a day south of New England, and joined another strong cyclone from Lake Huron; the center then passed just north of Nantucket. On-shore winds produced particularly heavy snowfall on the coast of Maine. The topographic control of snowfall distribution, or, perhaps more properly, the distribution of that which did not melt on striking the ground, is

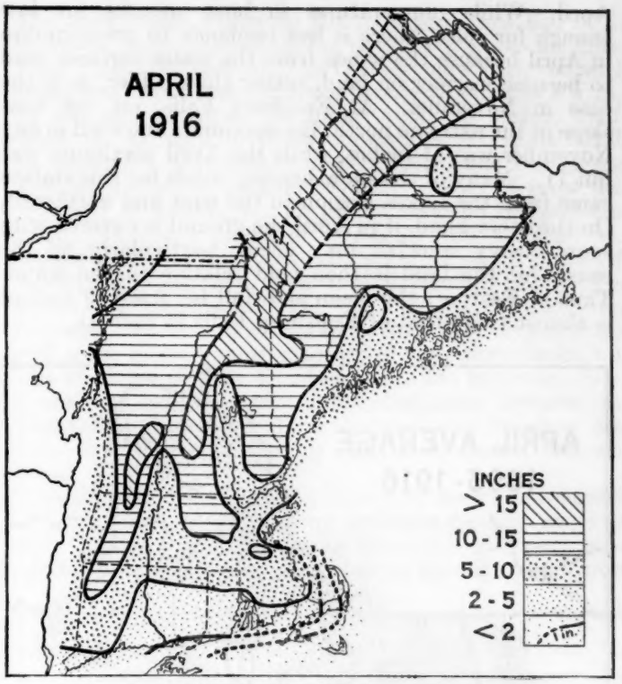

FIG. 21.—Snowfall of April, 1916. [Am. geogr. soc.]

marked. Nantucket, on the warm side of the storm, did not get much snow (1 inch). The record for April snowfall was established over almost all New England.

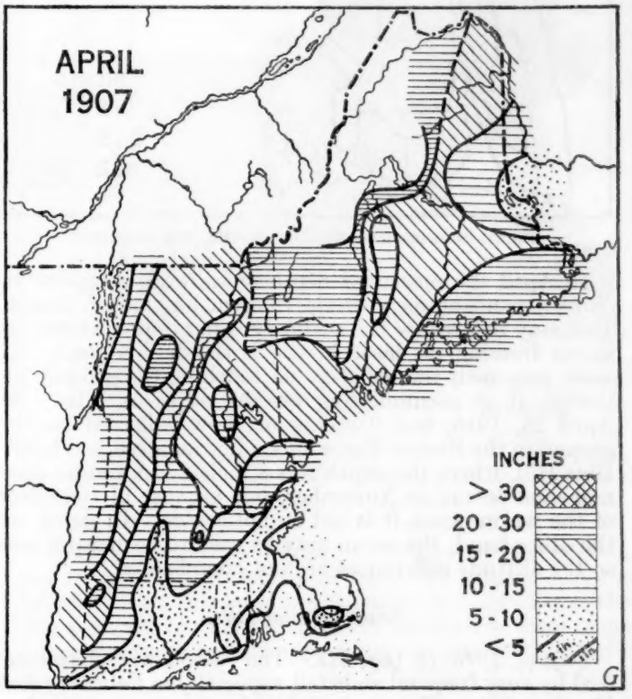

FIG. 22.—Snowfall of April, 1907.

April mean, 1896–1916 (fig. 23).—On the east coast April snowfall exceeds that of November; elsewhere November snowfall is in the lead. In the northwestern half of Vermont the November snowfall is double that of

April. While temperatures in both months are low enough for snow, there is less tendency to precipitation in April because the winds from the water surfaces tend to become warmer on land, rather than colder, as is the case in November. At Enosburg Falls, on the west slope in the extreme north, the maximum snowfall in any November was 51 inches, while the April maximum was but 11. Many of the snow-bearing winds for this station came from the Lakes Region to the west and northwest. On the other hand, if in April the ground is covered with snow, heavy snowfall may occur, particularly on the coast, for the land is then cold relative to the water. Thus at Eastport the mean snowfall for April (9 inches) is almost twice that of Enosburg Falls (5 inches).

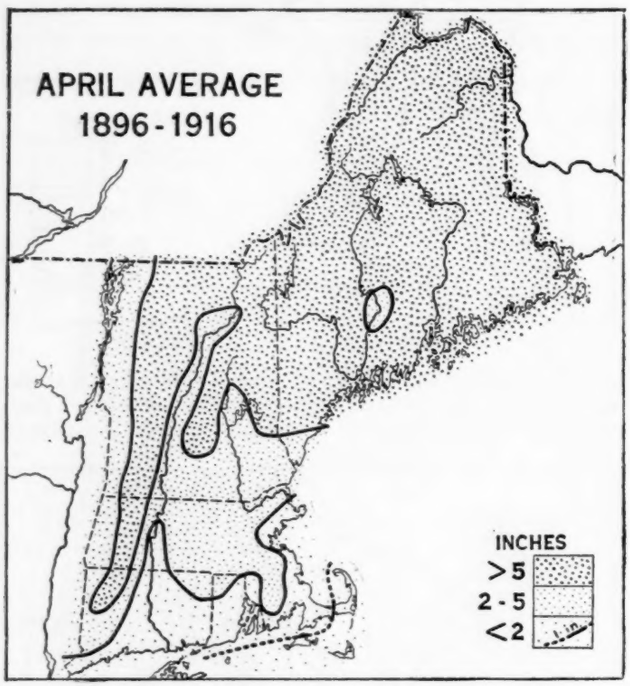

FIG. 23.—Mean snowfall of April, for 1896–1916. [Am. geogr. soc.]

In April the measured depth of snowfall seems to be more dependent on altitude than in any other month. This may be because the surface ground temperatures are above freezing, at least in the lowlands. So here, the snow may melt immediately on touching the ground, although it is accumulating on the adjacent hills. On April 28, 1916, but 2 inches of snow collected on the ground in the Boston Basin only a few hundred feet below Blue Hill, where the depth was 8 inches. A similar phenomenon occurs in November, but because of the effect of the warm ocean it is not so noticeable. In April, on the other hand, the ocean may be said to be neutral and so the altitude differences are not complicated.

Seasonal snowfalls.

Season, 1915–16 (fig. 24).—The season was characterized by very frequent snowfall, especially in February and March. Only a few storms stand out as extraordinary. Taking the season as a whole, there were 8 snowy cyclones passing to the north, 11 passing across, and 11 to the south of New England. Of the 11 cyclones bringing heavy snowfall, 4 passed through New England and the other 7 went by on the south. Three out of the four which went through New England occurred in December, leaving southeastern New England comparatively free of snow. The southern cyclones of late winter, however, made up for this early lack of snow. For the season, the result was an extraordinary snowfall, particularly in the

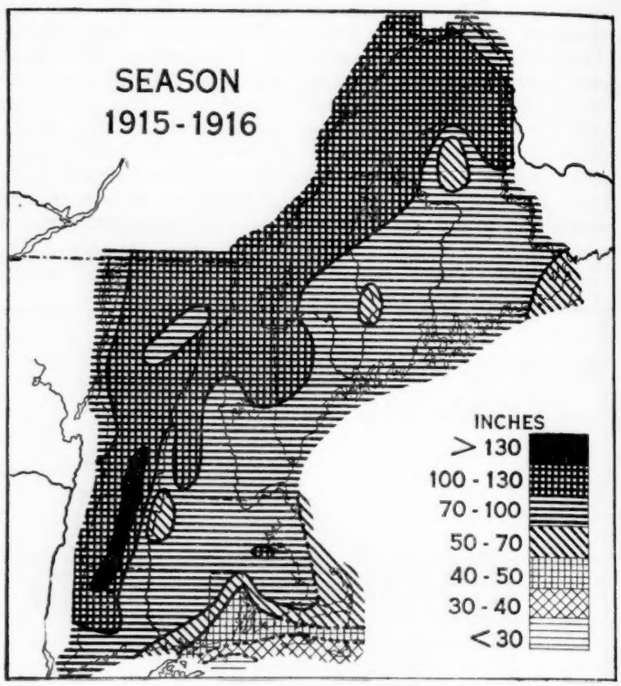

FIG. 24.—Seasonal snowfall for 1915–16. [Am. geogr. soc.]

west. The topographic control of the distribution of snowfall is patent. Especially interesting is the heavy snowfall of the Champlain Valley, which normally is in the snow shadow either of the Adirondacks or of the Green Mountains. In this season there was north wind with the snowfall. This produced heavy snows on the west side of the Green Mountains, giving records of 123 inches at Cornwall and 119 inches at Williamstown. Note the snow shadows east of the mountains. The 97 inches recorded at Springfield, Mass., may be due to the turn of the Connecticut River just below Springfield, which obstructs the clear sweep of a north-northwest wind down the valley in much the same way as at Brattleboro (see discussion of February, 1899, map p. 279).

TABLE 5.—*Contemporaneous snowfall differences on opposite sides of a mountain range.*

Station.	Average snowfall.	Length of record.	1895–96.	1915–16.
	Inches.	*Years.*	*Inches.*	*Inches.*
WEST SIDE.				
Williamstown, Mass	54	20	41	119
Cornwall, Vt	70	14	a 55	123
EAST SIDE.				
Vernon, Vt	68	8	60	86
Northfield, Mass	82	21	90	93

a 8 inches interpolated.

Season 1898–99 (fig. 25).—Many snow-bearing cyclones traversed New England or passed south or north. As a result the map presents an intensified picture of the average seasonal snowfall.

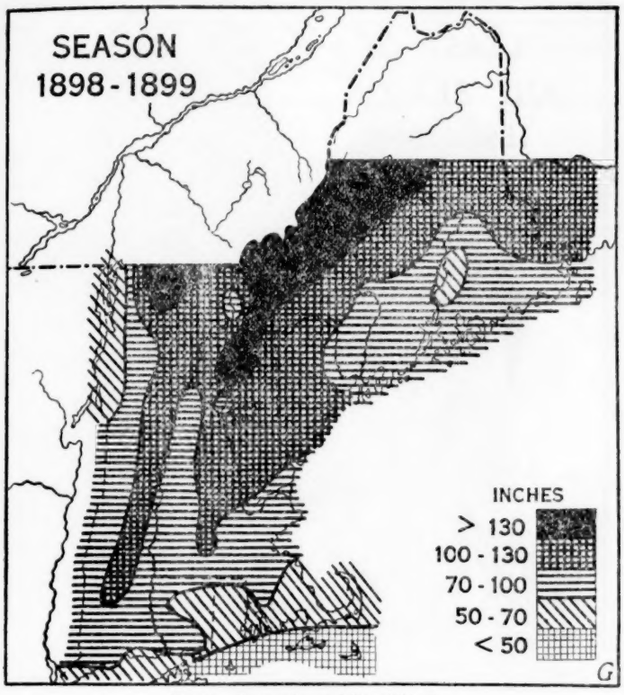

FIG. 25.—Seasonal snowfall for 1898–99.

Season, 1900–1901 (fig. 26).—Only one cyclone of this winter brought intense snowfall over any considerable area of New England. This passed through the region.

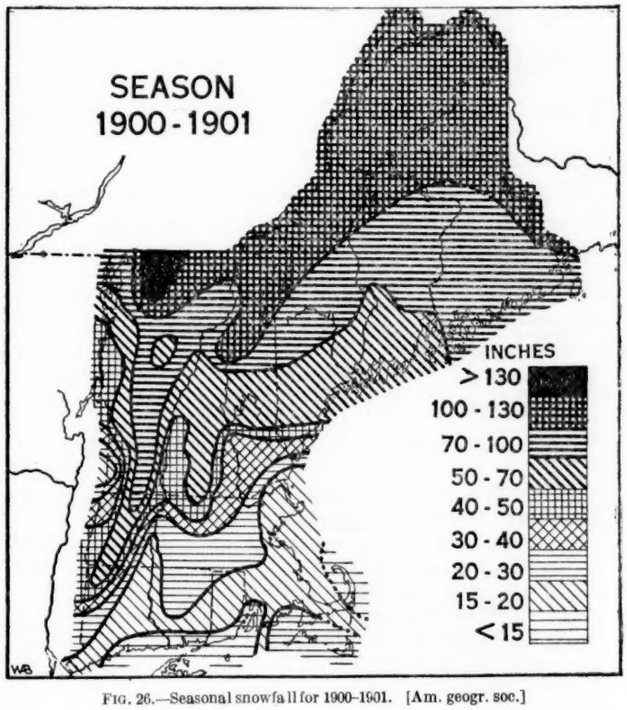

FIG. 26.—Seasonal snowfall for 1900–1901. [Am. geogr. soc.]

The west winds, following the passage of this and other cyclones, were responsible for the heavy snows at Enosburg Falls (192 inches). At Quebec snow occurred with southwest, west, and northwest winds 17 times at 8 a. m., in the four months, December, 1900, to March, 1901, while the average for these months, 1895–1913, is but 7, as shown on the weather maps. This same winter was that in which the maximum of 334 inches of snow was reported at Adams, N. Y., at the east end of Lake Ontario. In many places of southern New England the winter was that with the least snowfall in 21 years (cf. conditions of January, 1916, or of November, 1915). The snowfall at Burlington, Vt., was but slightly above the average, and that of Cornwall, a little farther south and still more in the "snow shadow" of the Adirondacks, was but 45 inches or only 4 inches above the minimum in 14 years of record. Under ordinary conditions, however, the snowfall at Cornwall is above the median in the same seasons that that at Enosburg Falls is in excess, and vice versa.

Season, 1906–7 (fig. 27).—Four very heavy snowstorms occurred, two accompanying cyclones passing south of New England and two going through. Eastport is so placed that it got heavy snowfall all through the winter.

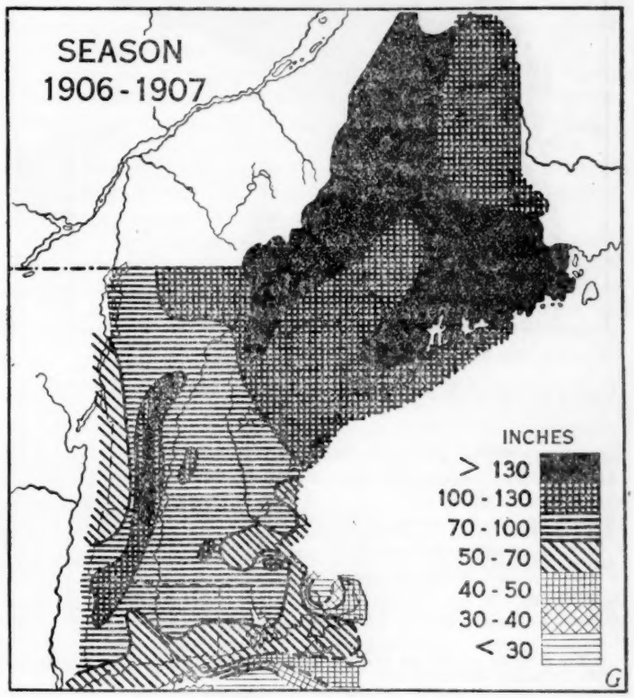

FIG. 27.—Seasonal snowfall for 1906–7.

Greatest snowfall in any season, 1895–1916 (fig. 28).—As the snowfall on the east side of the Green Mountains occurs largely with winds from the Atlantic, it is significant that the northern limit of 130 inches of snowfall in these mountains is directly opposite the southern limit of 130 inches in the White Mountains. The maximum of 82 inches at Nantucket is a little greater than that of most places in the southeastern half of the area including Massachusetts, Connecticut, and Rhode Island. This excess came in January, 1904, when Nantucket was surrounded with ice—giving it the character of the cold land to the north. The heavier snowfall came as a result of being nearer the cen-

ters of the passing cyclones, particularly that of January 2–3. The small snowfall of Block Island seems to show the effect of warmer water and of the land protection during northeast storms. The snowfall of January, 1904, may be taken as an example (fig. 11). In the southeast the distribution was as follows: Nantucket, 40 inches; Fall River, 33; New London, 33; Hyannis, 31; Plymouth, 26; Narragansett Pier, 22; Provincetown, 18; Block Island, 14 inches.

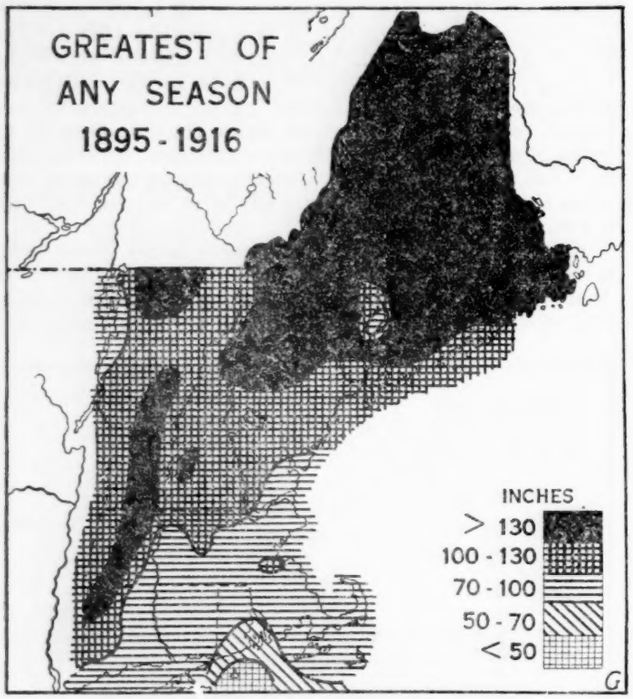

FIG. 28.—Greatest seasonal snowfall, for 1895 to 1916, inclusive.

TABLE 6.—*Monthly snowfalls during seasons with more than 150 inches.*

Station.	Season.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Total.
		In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Eastport, Me.	1906–7	3	14	35	36	45	29	26	5	*192
Enosburg Falls, Vt.	1900–1	0	34	33	49	36	38	2	0	192
Do.	1901–2	0	51	29	26	49	9	3	2	169
Jacksonville, Vt.	1903–4	T	5	38	67	23	9	16	0	*159
Do.	1904–5	1	14	43	61	44	13	2	T	178
Do.	1909–10	T	7	42	47	80	0	3	0	179
Somerset, Vt.	1915–16	0	8	42	12	30	54	15	0	161
Alstead, N. H.	1915–16	0	3	29	15	41	44	19	0	151

* The dropping of fractions in monthly totals makes the sum of the months differ from the seasonal totals by 1 inch.

Least snowfall in any season, 1895–1916 (fig. 29).—The minimum snowfall is, in general, about half as far below the average as the maximum is above, although in some places the average is halfway between the two. Thus, in most seasons the snowfall is below the average. In the north the minimum snowfall tends to come in cold or dry seasons. There is, then, but little topographic variation, for lowland temperatures are not high enough to melt some of the falling snow, or there is a lack of sufficient moisture to produce heavier precipitation on mountains than lowlands. (For the effect of a very cold month, see fig. 15, February, 1899.) In the south, on the contrary, cold winters are also snowy winters. So with the minimum occurring in warm winter seasons, differences in altitude are productive of marked snowfall differences, as is usually the case in April (see discussion of fig. 23).

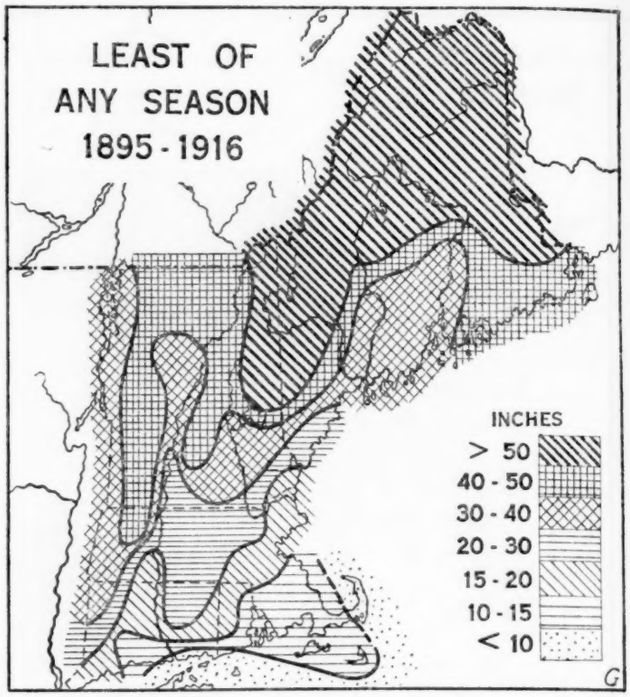

FIG. 29.—Least seasonal snowfall, 1895 to 1916, inclusive.

At Eastport, Me., and Enosburg Falls, Vt., the greatest and least seasonal snowfalls in the 21 years were the same. Yet the one is marine in location and the other is far inland on the west side of a mountain. Table 7 brings out the differences, however. The marine influence at Eastport is shown in the smaller variations and monthly extremes.

TABLE 7.—*Eastport, Me., and Enosburg Falls, Vt., snowfalls 1895–1916, compared.*

	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	Season.
Average snowfall:	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Eastport (53 ft.)	0	0.3	6	14	19	20	16	9	0.3	0	84
Enosburg Falls (436 ft.)	0	0.3	12	18	21	24	17	5	0.1	T.	[a] 97
Minimum snowfall: [b]											
Eastport	0	0	T.	4	6	9	2	0	0	0	45
Enosburg Falls	0	0	2	4	6	6	0	0.5	0	0	44
Maximum snowfall: [b]											
Eastport	0	3	15	35	36	45	33	26	5	0	192
Enosburg Falls	0	3	51	40	49	49	49	11	2	T.	192

[a] Nov., 1899, missing. [b] Months not all in the same season.

Mean departures of seasonal totals from the average: Eastport, 18 inches; Enosburg Falls, 25 inches.

Only in such places as the protected Champlain and upper Connecticut Valleys is the extreme range of seasonal snowfall less than the average seasonal total; in parts of New England it is double the average. This large range of 60 to 100 inches in general, but with extremes of 37 and 148, is an indication of what excessive snow a number of strong cyclones may bring.

Seasonal average, 1895–1916 (fig. 30).—The great snowfall of the exposed highlands, the local snow shadows and the relatively light snowfall of the coast show that the features apparent in the maps of individual seasons have sufficient repetition to be shown as usual phenomena. Only on the coldest part of the coast (Maine) does the heavy shore snowfall of the late winter make the total greater than that a short distance inland.

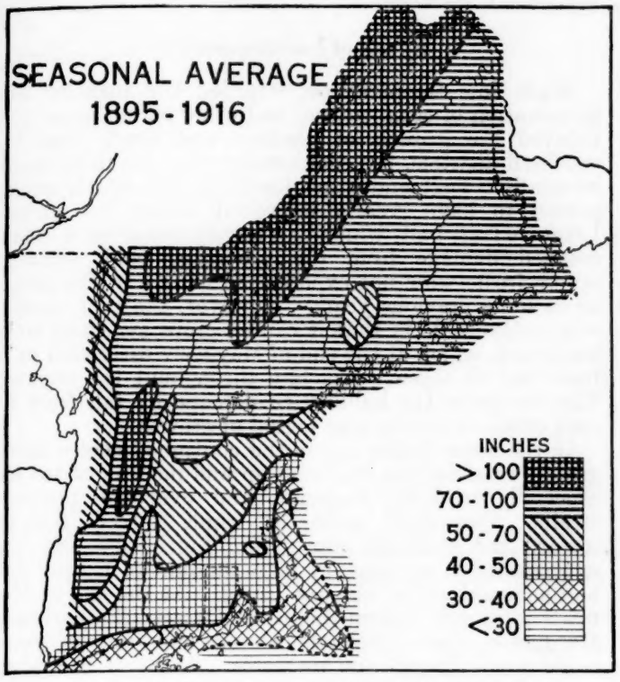

FIG. 30.—Mean seasonal snowfall, for 1895–1916. [Am. geogr. soc.]

SUMMARY.

Air temperature is probably the first factor in determining snowfall. The latitude and altitude differences in temperature cause the heaviest snowfall so far as controlled by temperature to be in the north and on the highlands. Similarly, the most snow tends to come in the coldest month, except in the north in winters colder than usual. Although January is as cold as February, the snow-bearing winds of February are the colder and so the snowier. The warmth of the coast is less favorable for snowfall than the coldness of the interior.

Without precipitation, however, there can be no snowfall. Precipitation is greatest on highlands near or facing bodies of water and near the paths of cyclone centers. The seasonal variations are small in amount.

Wind direction during precipitation is the third important factor controlling snowfall. Windward slopes of mountains and leeward shores tend to have the most precipitation. Combine the effects of these three factors, and the distribution of snowfall in New England may be explained. The highlands are the snowiest; for they are cold, moist, and windy. Particularly snowy are those slopes which are openly exposed to easterly or northeasterly winds or, as in the north, to the westerly winds from the Great Lakes. The intermontane valleys have less snowfall because of the higher temperature, less precipitation, and less exposure. In the coastal region there is plenty of precipitation, and open exposure, for the most part, so that the snowfall depends chiefly on the temperatures. Thus in early winter the snowfall is less than in late winter; in early winter the snowfall on the immediate coast is less than that inland, allowing for topographic influences; and in late winter the snowfall of the coast is the heavier. As New England is the focus of most of the cyclones which cross the United States or come up the east coast, there are chances for wide variations in their paths. On this account all parts of New England are crossed by numerous cyclones. As the strongest ones, however, pass south of New England or cross its southeastern portion, this section from time to time experiences extraordinary snowstorms, a great characteristic of the climate of New England.

THE COLD SPRING OF 1917.

By PRESTON C. DAY, Climatologist and Chief of Division.

[Dated: Washington, D. C., July 3, 1917.]

Beginning about April 24, and continuing to the middle of May, a period of three weeks, cold weather for the season of the year persisted to an unusual degree in nearly all portions of the country. The daily temperatures for the period, as shown by figure 1, were almost continuously below the normal, and the mean for the 21 days was likewise below the normal at practically every Weather Bureau station in the United States. The deficiencies for the period ranged from about 3 degrees per day near all the border lines, to 9 degrees over the interior districts, reaching extreme values as great as 12 degrees per day at local points from southeastern Wyoming to central Ohio.

After a brief interval of about one week with temperatures generally, though not materially, above normal over most districts east of the Rocky Mountains, another period of cold set in about May 22 and continued with but few interruptions until the end of the second decade of June, a period of about four weeks. In duration, amount of the departure below the normal temperature, and at times in area covered, this second cold period exceeded that first mentioned. For this period the mean temperature was below the normal over all portions of the country save along the Gulf and South Atlantic coasts, and at a few points in the far Northwest. Over all the interior portions the weather for these four weeks was almost continuously cold, the mean temperature ranging 6 to 8 degrees below the normal, with individual short periods having temperatures 10 to 20 degrees or more, below. The departures from the normal temperature for this period as a whole, are shown by figure 2.

Considering the month of May in its entirety the temperature averaged below normal in every portion where full reporting stations of the Bureau are located, save in extreme northwest Montana where a single station showed an excess of but a few tenths of a degree. This exception is probably due to an inadequate record for the normal.

An examination of previous records for May since 1872, the earliest year yielding Weather Bureau observations from coast to coast, does not disclose another instance when the average temperature for that month was so universally below the normal. In other years the negative departures over local areas, in a few cases, have been equal to or slightly greater than those for May, 1917, but in no case has the area covered equaled that of the month under discussion.

Causes of the low temperatures.

An examination of the daily weather maps, and the chart of average pressure and of prevailing wind directions for May 1917 (XLV—49) shows a preponderance of high atmospheric pressure to the north of the upper Lakes, and of low pressure over the northeastern districts, due to the frequent passage of storm areas moving from the southwestern States directly across New England. The winds over the districts from the Rocky Mountains eastward, were therefore largely from some northerly direction, and they carried with them the lower temperatures of the higher latitudes. Under normal conditions the prevailing winds are southerly over large areas of the eastern two-thirds of the country for the month of May, and carry with them the higher temperatures of the South. These conditions were largely reversed during May of the present year and cool northerly winds prevailed far south of their usual limits. This condition was particularly noted in portions of the Mississippi Valley and to the eastward.

The pressure distribution and wind directions were not, however, the only factors tending to lower the temperature. From the Ohio Valley northeastward, there was a marked absence of sunshine and daytime temperatures were consequently greatly reduced. Over much of this region the mean daily maximum temperatures ranged from 6 to 10 degrees below the corresponding normals, while the departures of the mean daily minima were generally about half as great. Similar conditions prevailed in portions of the Rocky Mountains district where, partly on account of absence of sunshine, the mean daily temperature maxima were from 8 to 12 degrees below normal, while the mean minima departures were scarcely one-third as great. In the northern Plains States reverse conditions existed, and under the influence of clear skies and dry weather the maximum temperatures were actually higher than the normals, but the intense radiation at night, as a result of the dry and clear conditions of the atmosphere, caused the night temperatures to go sufficiently low to overbalance the daytime excess and give monthly means below normal.

Frosts not severe.

Despite the continued cold, extremely low temperatures were not of frequent occurrence, in fact at only one station, El Paso, Tex., did the minimum temperature for May reach a lower point than had been previously reported in that month. Lower minimum temperatures in May than reported this year have been rather frequent in the past. For example, at Columbus, Ohio, during the past 20 years, minimum temperatures as low as, or lower than, reported at that station during May, 1917, are of record in about one-half the years. Neither were frosts so severe as have occurred in the same month of other years, in fact the southern limit of killing frost during May, 1917, was far north of the limit attained in May of some preceding years.

Cool weather and rainfall.

Cool weather during May is, as a rule, accompanied by considerable precipitation, because barometric pressure conditions responsible for cool weather in this month are also such as to favor considerable rainfall. During May, 1917, however, large areas with rather marked cool weather, had also deficient precipitation. This was especially the case in the northern border States from the Lakes Region westward to and including the northern portion of Montana. In this area rainfall during the month was unusually light, large areas receiving less than a tenth of an inch. Rainfall was likewise light, or negligible, over considerable areas in the Atlantic and Gulf States, especially the latter. In the principal corn belt, however, the month was nearly everywhere wetter than usual, which was also the case in some districts west of the Rocky Mountains.

Effects of low temperature.

While low temperatures retarded the planting and germination of corn, cotton, and other spring crops, and delayed the growth of gardens and truck over the southern districts, the cool weather was not unfavorable to winter wheat and other hardy cereals which are reported to have greatly improved during the month. Likewise fruit buds which had largely remained dormant escaped damage from the prevailing cold, although severe frosts were not experienced as late in the month as in some previous years. However, the cool weather was unfavorable in that it caused crops generally to be backward, which at the end of May were estimated to be from one to three weeks late throughout the country. This increases the liability to damage by fall frost for such crops as have a long period of growth.

In the upper Lakes region the continued cool weather greatly retarded the breaking up and melting of the ice, especially in Lake Superior, and over the northern straits. Prevailing northerly winds forced the ice toward the southern shores and much difficulty was experienced in moving the large amount of freight that had accumulated at the Soo Canal. At the end of May boats were still held in the ice at Duluth, the harbor at Marquette was completely closed and not a vessel could move through the ice fields. At Sault Ste. Marie navigation was greatly delayed and much loss to transportation interests resulted. It is stated that not for many years has ice in the Lake Superior region hindered navigation so late in the season. As an indication of the serious interruption to traffic, the report of the general superintendent on lake commerce through the canals at Sault Ste. Marie shows that the tonnage passing through the canals during April and May of the present year was less than 65 per cent of the amount carried in these months during the preceding year, despite the probable greatly increased demands for transportation.

Press dispatches as late as June 6 stated that the harbor at Duluth was at that time tightly icebound and that a number of vessels had been caught in a solid field of ice about half a mile outside the harbor.

TEMPERATURE CONDITIONS PRECEDING THIS COOL SPRING.

East of the Rocky Mountains, except in Montana, temperature conditions for the last year or more have presented no unusual features, there being no noteworthy departures from the normal for any period of considerable length. However, in Montana and from the Rocky Mountains westward the 13 months from May, 1916, to May, 1917, inclusive, were remarkable in that the temperature remained persistently, and in some cases decidedly, below the normal except in limited areas for a few of the months. In the central portion of the Plateau region conditions were specially remarkable during this period, each of the 13 months showing negative departures. At Winnemucca, Nev., the temperature

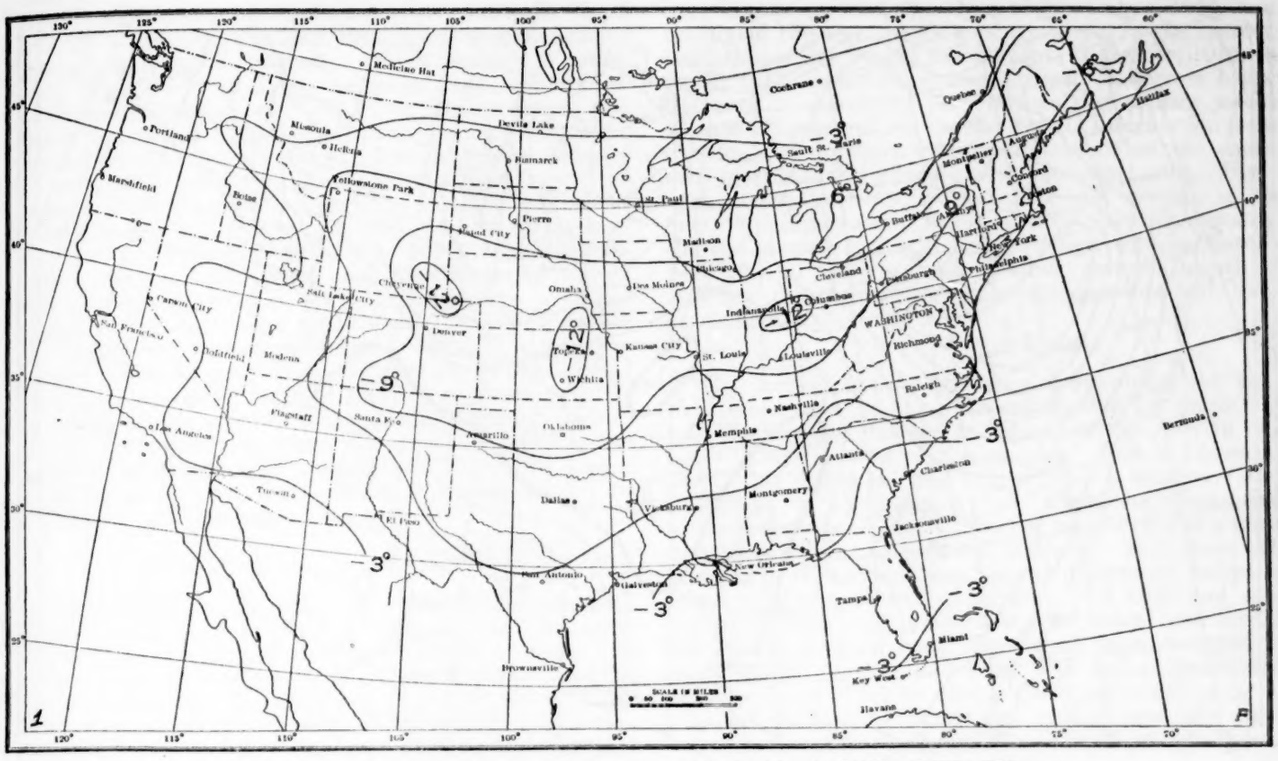

FIG. 1.—Map of mean temperature departures from the normals for the 21 days April 24–May 15, 1917. (°F.)

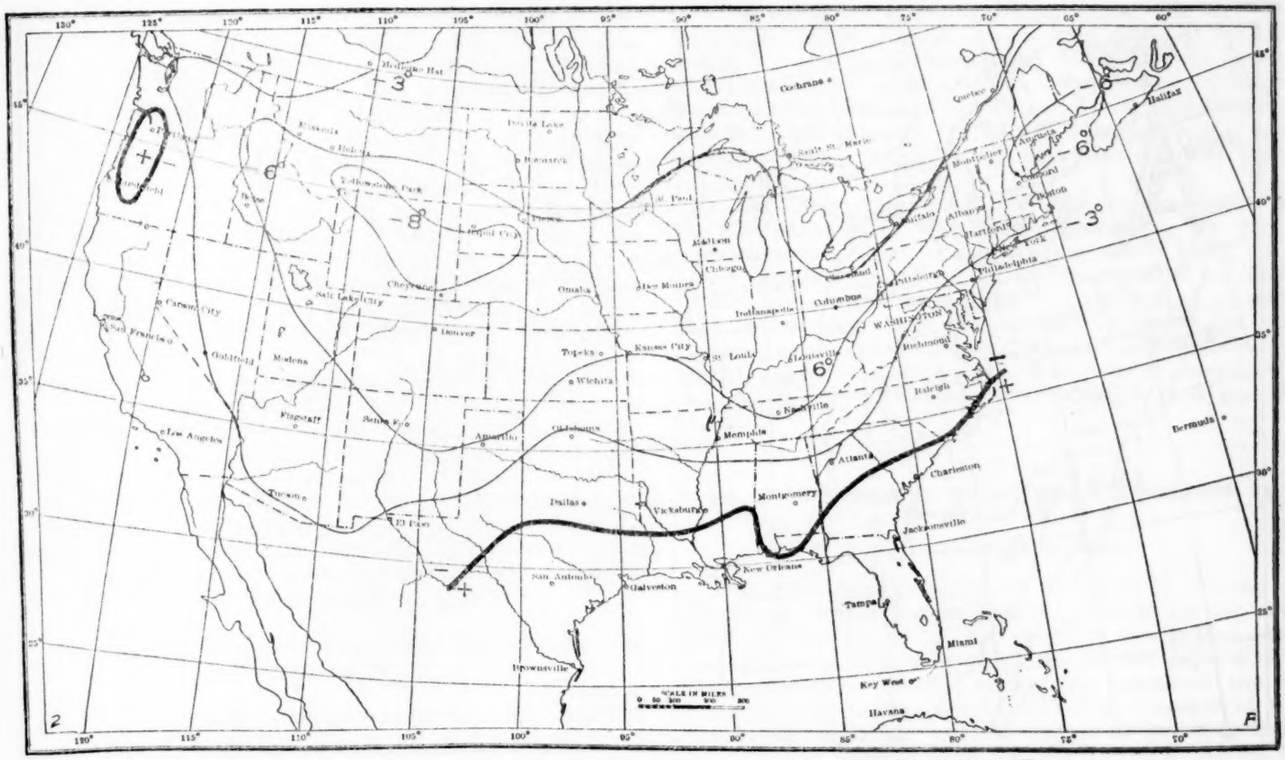

FIG. 2.—Map of mean temperature departures from the normals for the 28 days May 22–June 19, 1917. (°F.)

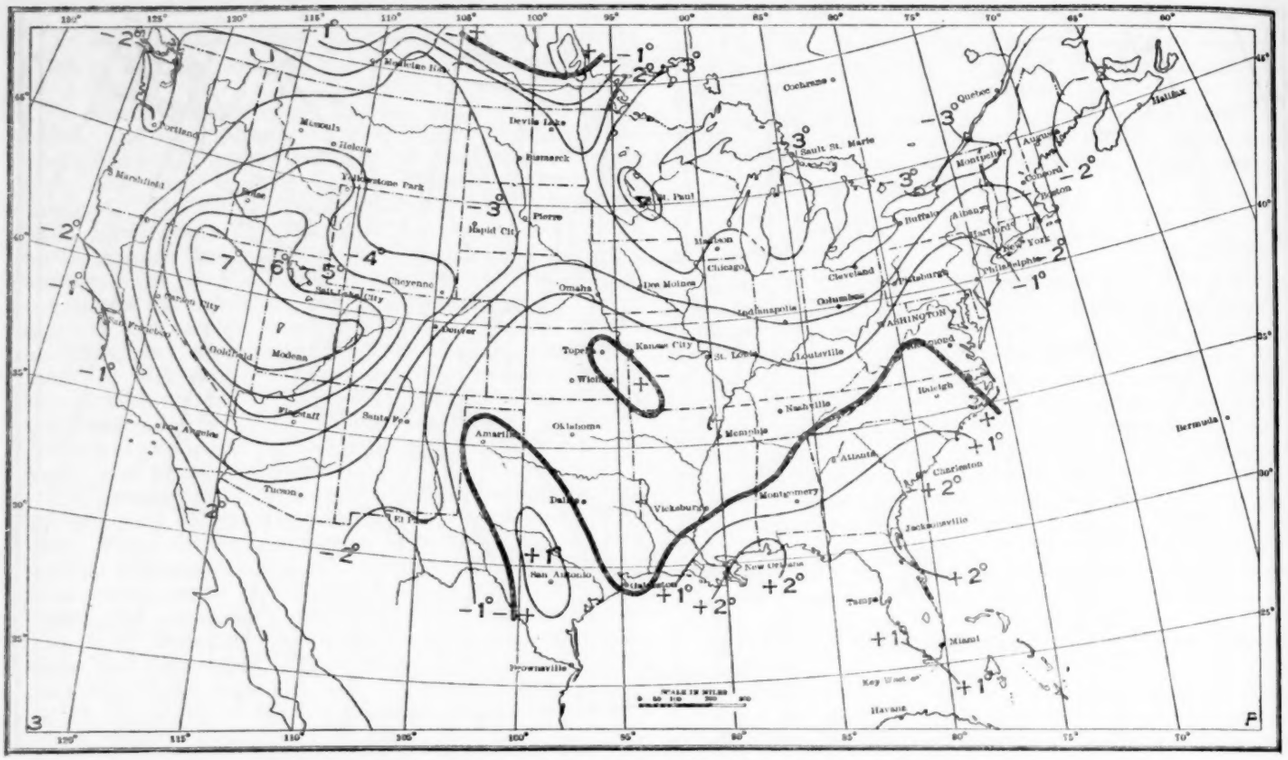

FIG. 3.—Map of mean temperature departures from the normals for the 151 days January 1–May 31, 1917. (°F.)

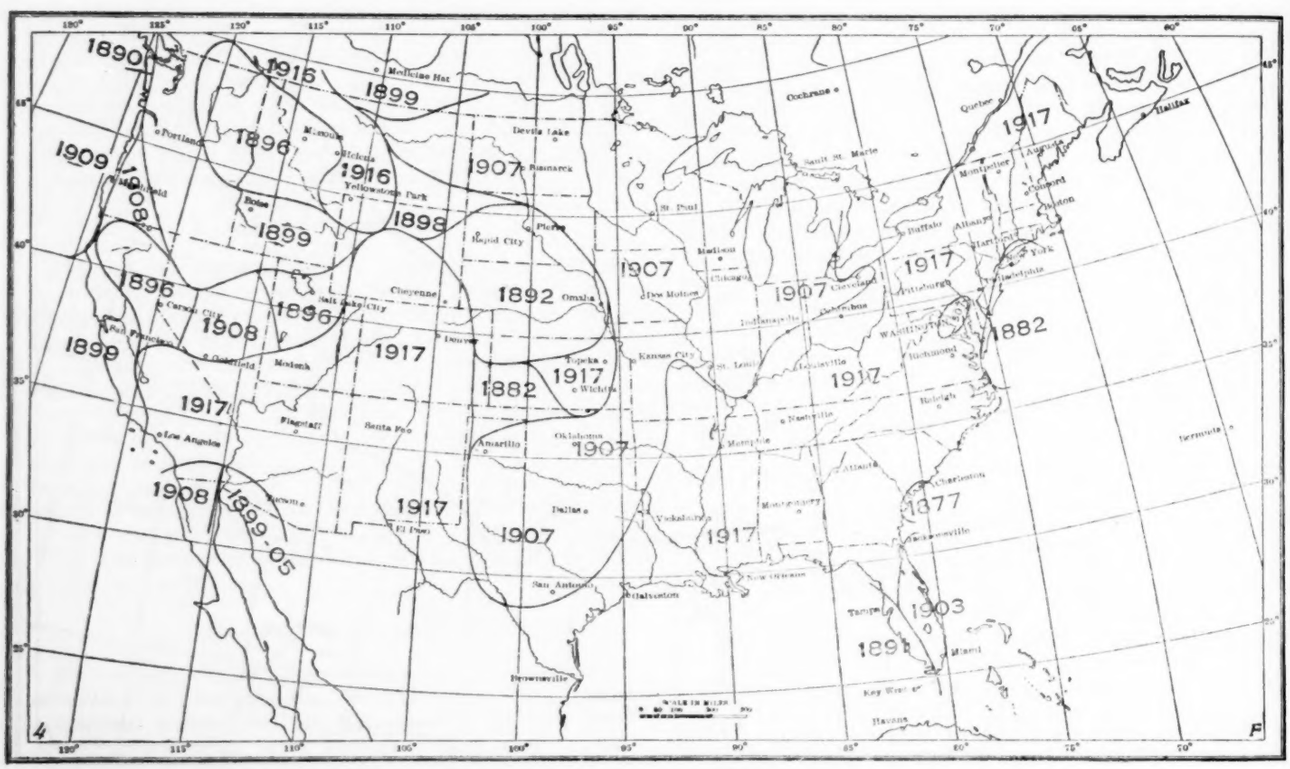

FIG. 4.—Map indicating the years showing the lowest mean temperature for May, and the areas affected. 1877–1917.

averaged about 4.5 degrees per day below the normal for the 400 days prior to June 1, 1917, while for the 5 months from January to May, 1917, the average deficiency was about 7 degrees per day. From January 8 to 26, 1917, a period of 19 days, the mean daily temperature at Winnemucca was only 5.3° F., or 23 degrees per day below the normal. The temperature departures from the normal for different sections of the country from January to May, 1917, inclusive, are shown in figure 3.

Subnormal temperatures persisted in all or portions of Montana also during 8 months of 1916 and for each of the 5 months from January to May, 1917. The temperature in the northern portion of that State for the 17 months January, 1916, to May, 1917, inclusive, averaged 4 degrees per day below the normal. At times during this period Montana experienced extremely low temperatures. From January 2 to February 12, 1916, a period of 42 days, the daily mean at Havre was about −12°F., or 26 degrees per day below the normal. During December of the same year there was another, but shorter, period of extremely cold weather recorded at this station when for 11 days the temperature averaged −14°F., or 32 degrees per day below the normal.

Lowest mean May temperatures.

Figure 4 shows the years in which the lowest mean May temperatures of record occurred and the areas affected, as revealed by records for about 45 years. It will be noted by referring to this chart that 1917 had the lowest mean May temperatures of record for a larger area than any other year in which low records were established in this month. The area covered in 1917 embraces practically the whole of the New England, Atlantic, and Gulf States, the eastern Lakes Region, Ohio Valley, Tennessee, and the middle Mississippi Valley. Likewise the middle and southern Rocky Mountains region, Arizona, portions of Utah, Nevada, and California had, on the whole, the coldest May since extensive temperature records have been maintained.

The year 1907 was that in which the lowest mean May temperatures of record occurred over the next largest area. The low records established in May of that year, cover much of Texas, Oklahoma, Arkansas and Missouri, the upper Mississippi Valley, and also most of the Lake region and the northern border States westward to Montana. However, in considerable portions of the area in which low May records were established in 1917, the monthly means were only slightly lower than those recorded in 1907.

In sections of the country in which the lowest mean May temperature occurred in years other than 1907 and 1917, the areas affected in individual years were comparatively small and the cool conditions were more largely the result of local causes. In most of South Dakota, in Nebraska, and in the northern portion of Kansas, the lowest mean May temperatures of record occurred in 1892, while in much of the northern Rocky Mountain and central and northern Plateau districts the lowest records were made in 1896 or 1899.

COLD WEATHER IN EUROPE DURING THE WINTER AND EARLY SPRING OF 1917.

While temperature conditions in the United States east of the Rocky Mountains, during the past winter and up to and including the most of April were not unusual, reports from Europe indicate that this period was characterized by severely cold weather and heavy snowfall. Unseasonably cold weather is reported to have set in over Europe toward the close of November, 1916, and continued till near the close of April, 1917. In London the temperature for the five months, December, 1916, to April, 1917, inclusive, averaged nearly 4 degrees below the normal, this being very unusual for a place whose climate is largely of the marine type. Information from western and northern Europe indicates that the continent was similarly affected with prolonged cold. However, about the time the period of cold weather set in over the central and eastern portions of the United States, the last decade in April, the persistent cold in Europe gave way to much warmer weather, and the month of May was rather remarkable for unseasonably high temperatures.[1]

OTHER COLD SPRINGS.

With respect to cold springs and summers, the year 1816 stands out as the most memorable for persistent cold weather and damage to vegetation, not only in this country, but in most of Europe also. This is known in the United States as "the year without a summer," and in Europe as "the famine year." From the information at hand there is no doubt that the year 1816 was a most disastrous one for agricultural interests. In it there culminated a remarkable depression of summer temperatures which began with the summer of 1811 and continued till 1817. In portions of the Central and Northern States snow or frost appears to have occurred in every month of 1812 and 1816, and well-authenticated reports of loss of life by cold in the summer of the latter year are on record. Fruits and grains, especially corn, either partially or wholly failed to mature, resulting in a scarcity of food not known since that time.

The year 1859 was also remarkable for the cold weather experienced during the late spring or early summer. In that year, about June 5, severe cold weather for the season occurred in the Middle and North Atlantic States and Ohio Valley, temperatures several degrees below freezing being reported from many places, and freezing weather was general in western Pennsylvania and northern Ohio. Ice 2 inches thick was reported from Johnstown, Pa.

In 1882 May was remarkably cold for the season in the districts east of the Rocky Mountains, the mean temperatures for that month at many places being only 1 or 2 degrees higher than the lowest of record for May.

May, 1907, stands next to 1917 as a month of unusual cold, as has been noted previously, but despite the low temperatures staple crops were not materially reduced in yield. Likewise in May, 1910, there was a general and large deficiency in temperature in central and eastern districts.

SOME ASPECTS OF THE COLD PERIOD, DECEMBER, 1916, TO APRIL, 1917.

[Nature, London, June 28, 1917, 99: 359.]

R. C. Mossman presented, at the June 20 meeting of the Royal Meteorological Society, remarks on this subject. In the course of his remarks the author said that the mean temperature of the British Isles during the period under notice, taking the means of the 12 divisions used in the Monthly Weather Reports of the Meteorological Office, was 1.9 degrees C. below normal, the extremes ranging from 2.8 degrees below normal at

[1] In this connection see following abstract of address by R. C. Mossman as published in Nature, June 28, 1917.—*Editor.*

Belvoir Castle in Leicestershire and 2.7 degrees below at Newquay, up to only 0.5 degree below normal at Castle Bay in the Hebrides. Except in December, the cold was general over western Europe with the mean temperature of Sweden 1.9 degrees below, of Holland 2.7 degrees below, and of Norway 1.5 degrees below their respective normals; while as far south as Gibraltar the mean was 1.1 degrees below the average. It was shown that when the eastern portions of the British Isles had a mean temperature below the normal in each month from December to April—an event that had occurred only five times during the last century and a half—there was then a pronounced tendency for the depression of temperature to continue without interruption until the end of the year. The only exception occurred in 1808, when a warm period covering the four months from May to August was sandwiched in between two cold spells. The frequent absence of historic frosts during long periods of uniform cold over the British Isles was also referred to.

ACCIDENTAL PRESSURE VARIATIONS IN THE UNITED STATES.

By ALFRED J. HENRY, Professor of Meteorology.

[Dated: Weather Bureau, Washington, D. C., July 6, 1917.]

A recent article by Dr. A. Defant on the daily, nonperiodic pressure variations in the United States [1] recalls to my mind some work on the same subject on which I was engaged about 12 years ago. This work was undertaken at the suggestion of the late Professor Abbe, who at that time was in correspondence with the Russian meteorlogist Woeïkof [Voeïkov] on the subject of the mean pressure variation in 24 hours. Press of other work prevented the completion of the study as originally planned, and the matter was laid aside for the time. The conclusions reached coincide quite closely with those announced by Dr. Defant, who has considered the mean hourly values as printed in the Annual Reports of the Chief of the U. S. Weather Bureau for 1898 to 1902 (4° edition).

It is convenient to think of the nonperiodic or accidental pressure fluctuations as advancing wavelike from west to east and as standing in close relation to the problem of weather forecasting, hence the very great interest of forecasters in the subject.

It has been known in a general way for many years that the changeable character of the weather on this continent is closely related to areas of rising and falling pressure that move at irregular intervals across the country from west to east. It has occurred to the writer that an examination of these waves of rising and falling pressure might lead to some interesting, if not valuable, results. There are several ways of attacking the problem, depending on the particular object in view.

Both the duration and amplitude of waves of rising or falling pressure can be obtained directly from the barograms, but since this method involves the measurement of a great number of instrumental records, a less precise plan was adopted, viz, that of taking the difference between the 8 a. m. "station pressure" [2] of one day as compared with that of the succeeding day at the same hour, and affixing the proper algebraic sign. This has been done for a period of ten years, 1894–1903, for two stations on the Pacific coast, Portland, Oreg., and San Diego, Cal.; three stations in the Mississippi Valley, St. Paul, St. Louis, and New Orleans; and two stations on the Atlantic coast, Eastport and Key West. The record covers 3,650 days at each station, and shows in detail whether pressure was rising or falling and the amount of the change.

Number of periods of falling pressure and average interval.—The total number of periods of falling pressure for the several months of the year is given in Table 1. If the total number of periods of falling pressure of whatever length be divided into the number of days in the period, the average interval between two successive periods will be found. These data also appear in the table. The geographic coordinates of the stations are as follows:

	Lat. N.	Long. W.
Portland, Oreg.	45° 32′	122° 43′
San Diego, Cal.	32 43	117 10
St. Paul, Minn.	44 58	93 03
St. Louis, Mo.	38 38	90 12
New Orleans, La.	29 58	90 04
Eastport, Me.	44 54	66 59
Key West, Fla.	24 33	81 48

TABLE 1.—*Total number of areas of falling pressure (katallobars),* and average time interval between them, in the 10 years 1894–1903.*

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average, annual.
Pacific coast.													
Total number:													
Portland, Oreg.	81	83	80	74	78	75	70	85	72	75	82	80	93
San Diego, Cal.	77	66	75	74	72	72	70	72	67	72	71	74	86
Average interval (days):													
Portland, Oreg.	3.8	3.4	3.9	4.1	4.0	4.0	4.4	3.7	4.2	4.1	3.7	3.9	3.9
San Diego, Cal.	4.0	4.3	4.1	4.0	4.3	4.2	4.4	4.3	4.5	4.3	4.2	4.2	4.2
Mississippi Valley.													
Total number:													
St. Paul, Minn.	92	69	80	73	77	70	76	87	80	79	83	82	95
St. Louis, Mo.	88	71	73	71	79	63	70	73	70	73	78	83	89
New Orleans, La.	75	72	70	69	66	64	64	75	67	68	74	75	84
Average interval (days):													
St. Paul, Minn.	3.4	4.1	3.9	4.1	4.0	4.3	4.1	3.6	3.8	3.9	3.6	3.8	3.8
St. Louis, Mo.	3.5	4.0	4.3	4.2	3.9	4.8	4.4	4.3	4.3	4.3	3.8	3.7	4.1
New Orleans, La.	4.1	3.9	4.4	4.3	4.7	4.7	4.8	4.1	4.5	4.6	4.1	4.1	4.3
Atlantic coast.													
Total number:													
Eastport, Me.	88	75	76	75	77	79	72	80	80	84	82	86	95
Key West, Fla.	70	68	65	60	56	64	66	66	59	58	59	62	75
Average interval (days):													
Eastport, Me.	3.5	3.8	4.1	4.0	4.0	3.8	4.3	3.9	3.8	3.7	3.7	3.6	3.8
Key West, Fla.	4.4	4.2	4.8	5.0	5.5	4.7	4.7	4.7	5.1	5.4	5.1	5.0	4.9

* Using the nomenclature of Ekholm.

The results of the compilation show that practically all of the pressure falls (katallobars) pass entirely across the United States from the Pacific to the Atlantic; that is to say, the number entering the continent on the Pacific coast is practically the same as that leaving the continent on the Atlantic coast at Eastport, Me. The average number which passes St. Paul, Minn., in the interior is slightly greater than that which enters the continent over the coasts of Washington and Oregon. The number is somewhat larger at northern than at southern stations, and the maximum for any month generally falls in the winter, although there is the suggestion of a secondary maximum in August, which at Portland, Oreg., becomes the primary maximum.

Duration of katallobars.—Along the northern boundary of the United States falling pressure, in a little more than

[1] *Defant, A.* Die täglichen unperiodischen Druckschwankungen im Gebiete der Vereinigten Staaten von Nordamerika. Meteorol. Ztschr., Braunschweig, November 1916, 33: 503–510. 3 figs.

[2] "Station pressure" for a Weather Bureau station is the corrected pressure for the station a the altitude of the station.

50 per cent of the cases, is succeeded by rising pressure after an interval of 24 hours or less; but in the southern part of the country the number of cases of falling pressure continuing for two consecutive days is decidedly greater than in the north. The details for the months of January and July are shown in Table 2, expressed as percentages of the total number of cases. For example, at Portland, Oreg., the interval was 24 hours or less in 46 per cent of the total number of cases; 48 hours or less in 35 per cent of the cases, etc.

TABLE 2.—*Percentage frequency of the intervals stated, between katallobars at the several stations in January and in July (1894–1903).*

Stations.	JANUARY. Interval in days.							JULY. Interval in days.						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.	P.c.
Portland, Oreg.	46	35	12	6	0.5	....	0.5	36	36	18	7	3	0.5	....
St. Paul, Minn.	56	32	10	0.5	0.5	0.5	....	50	33	14	2	1	....	....
St. Louis, Mo.	55	23	10	11	2	....	....	30	33	19	12	5	0.5	0.5
Eastport, Me.	56	31	8	2	2	0.5	....	25	44	18	7	6	....	....
San Diego, Cal.	33	37	17	12	0.5	....	0.5	38	39	19	4	....	....	....
New Orleans, La.	32	38	19	10	0.5	....	0.5	30	43	24	3	....	....	....
Key West, Fla.	33	38	16	1	6	5	0.5	32	43	16	9	1	....	....

The greatest number of consecutive days with falling pressure at any of the stations in the United States was seven; a few cases were recorded where the pressure was either stationary or falling for eight and nine consecutive days, but these cases were rare. When the fall was long continued the amount day by day was small, especially at southern stations. One case was noted, however (Eagle, Alaska, from Dec. 14–21, 1899), where the aggregate fall for eight consecutive days was 1.66 inches. This amount in hundredths of inches was distributed as follows: 0.18, 0.37, 0.20, 0.42, 0.13, 0.25, 0.01, and 0.10.

Mean daily accidental variations.—The mean daily accidental pressure fluctuations, in inches of mercury, for the 10 years are given in Table 3. This table clearly shows that the greatest daily accidental changes in pressure are found off the Maine coast. Additional observations in this region would probably show that even greater fluctuations are the rule over the Grand Banks and the continental districts adjacent thereto.

The amplitude of the variations diminishes from north to south in a striking manner.

TABLE 3.—*Mean daily accidental pressure variations for the 10 years 1894–1903.*

Stations.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Portland, Oreg.	0.17	0.17	0.18	0.15	0.12	0.10	0.08	0.08	0.11	0.13	0.18	0.17
San Diego, Cal.	.08	.08	.07	.06	.05	.04	.04	.04	.04	.05	.06	.07
St. Paul, Minn.	0.24	0.21	0.23	0.17	0.15	0.12	0.11	0.12	0.16	0.19	0.20	0.23
St. Louis, Mo.	.20	.20	.21	.14	.10	.08	.07	.07	.09	.12	.17	.20
New Orleans, La.	.13	.14	.12	.08	.05	.04	.04	.04	.04	.06	.08	.12
Eastport, Me.	0.33	0.30	0.31	0.20	0.17	0.15	0.13	0.12	0.18	0.23	0.24	0.28
Key West, Fla.	.07	.07	.06	.05	.04	.03	.03	.03	.04	.05	.05	.06

In general we perceive from this study that the accidental pressure fluctuations are somewhat more numerous and of greater amplitude in higher than in lower latitudes, and that, as a corollary, the time interval between successive katallobars increases from north to south. All of this is in harmony with the experience of weather forecasters on the North American Continent.

THE TORNADOES AND WINDSTORMS OF MAY 25–JUNE 6, 1917.[1]

By H. C. FRANKENFIELD, Professor of Meteorology.

[Weather Bureau, Washington, D. C., July 20, 1917.]

INTRODUCTION.

During the Spring severe local storms may reasonably be expected over some sections of that portion of the United States lying east of the Rocky Mountains, and the years without such severe storms are rare indeed. The conditions leading up to these unwelcome visitations do not occur in such complete form in any other portion of the Northern Hemisphere, but they are clearly defined and are very largely incident to topography. Examine a map of the globe and it will be seen at once that no other portion of the Northern Hemisphere presents a similar arrangement of wide expanse of relatively warm land with, or open to, warm subtropical and tropical waters to the south and southeast and a limiting mountain wall to the westward. At times when certain systems of pressure distribution prevail over the continental interior warm moisture-laden winds from the south and southeast are carried inland and finally encounter the colder north and northwest winds descending along the eastern slopes of the north-and-south barrier. Given these warm south and southeast winds and the cold north and northwest winds, it is apparent that in the region where they meet, and closely adjacent thereto, great interchanges of heat will occur and give rise to phenomena whose intensity will vary with the degree of contrast in the original conditions.

According to Murray, the word "tornado" is evidently of Spanish or Portuguese origin. Its earlier English spelling was *ternado*, probably a corruption of the Spanish *tronada*, or thunderstorm, while *tornado* may have been an attempt to improve *ternado* by treating it as a derivative of the Spanish *tornar*, to turn or return. This spelling is identified with explanations in which not the thunder, but the turning, shifting, or whirling winds are the main features. The sixteenth century navigators applied the term to the violent thunderstorms of the tropical Atlantic with their torrential rains and sudden violent gusts of wind, but this usage is no longer current in the United States.

By tornado we now mean a violent rotary windstorm of restricted diameter, accompanied by rain, and usually by hail, lightning, and thunder. The air masses whirl with great velocity about a central axis, while the whole storm moves along a narrow path across the country with considerable speed, usually between 40 and 50 miles an hour. The width of the path of greatest violence may vary from a few rods to as much as a mile. The tornado cloud is of a black, or ugly gray-black color and usually, although not always, with one or more pendant, funnel-shaped clouds which may or may not reach the earth. The existence of the funnel cloud is entirely in accord with the theory of the tornado and it is not unreasonable to assume that it is always present, but that in instances where it was not observed the main body of the storm cloud swung too close to the earth, cutting off the pendant, or else it may be invisible in the absolute darkness that frequently attends tornadoes.

Tornadoes almost invariably develop in the southeastern quadrant of an area of low pressure, and they may occur at a distance of a much as two or three hundred miles from the center of the depression, originating as a secondary depression in which the ascent of warm and moist air over a region accompanied by a contraclockwise movement of winds directed spirally inward, plays

[1] Accompanied by Charts XLV–59 to XLV–67, inclusive.

an important rôle. This rapidly gyrating movement of the winds which distinctly characterizes the tornado is responsible for the major portion of its destructiveness. Further elaboration as to the origin and development of the tornado and the reasons therefor need not be entered upon here.

ANTECEDENT WEATHER CONDITIONS.

The spring of 1917 was abnormally cold over the greater portion of the United States, and almost continuously so. As a natural sequence the prevailing pressure distribution was largely of a single type, high to the northward and low to the southward. Most frequently the storm movement was from the southwest to northeast across the central portion of the country, the depressions either moving to the northeastward over the upper Lakes or down the St. Lawrence Valley. This condition of affairs continued through the first week of June, but, as temperatures remained low in the south and southeast until after May 20, there were no severe storm developments previous to that time.

THE TORNADOES.

The tornadoes and heavy wind storms of late May and early June were primarily due to a number of low areas of the Colorado, or southwestern type, which moved northeastward across the interior of the country with such frequency and regularity as to constitute a remarkable series. From May 17 to June 3, inclusive, there were 8 of these disturbances, all well-defined and pronounced in character. Directly after they began to develop and move, temperatures naturally rose to the southward and southeastward with the inflow of southerly winds. The evening weather charts for the days involved are reproduced herewith (Charts XLV–59 to XLV–67), whereon appear also the tracks of the tornadoes. The tracks of the tornadoes and storms so far as they were obtainable are also shown in more detail by figure 1. Although the majority of the storms occurred before 8 p. m., it was thought best to reproduce the evening weather maps

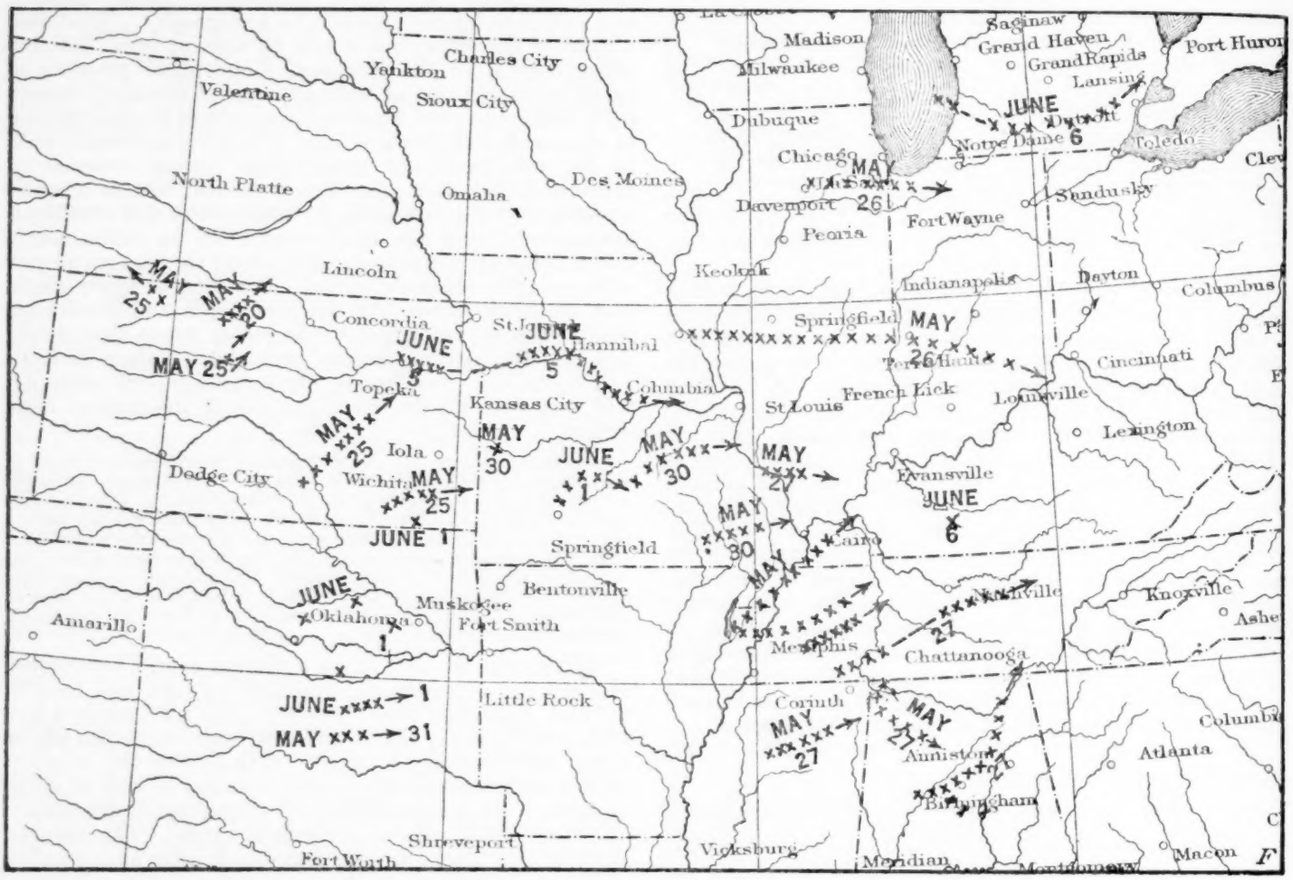

FIG. 1.—Tracks of tornadoes and severe local storms in the Central States, May 20 to June 6, 1917, inclusive.

which are not ordinarily published. The movements of the centers of the parent cyclones since the preceding morning (8 a. m. map) are shown by solid long arrows.

On the morning of May 20 the second of this series of depressions was central over eastern Colorado with an east-northeastward movement, with cold rain to the northward and northeastward and moderate temperatures to the southward with generally clear weather. Relative humidity was high, ranging from 78 to 95 per cent over southern Kansas and Oklahoma. During the day the disturbance moved eastward, being central at 8 p. m. over southeastern Kansas, and at 6 p. m. the first tornado appeared about 12 miles southwest of the town of Plainville, Rooks County, Kans.

The Kansas storms of May 20.

This tornado moved north-northeastward with a width of track ranging from 200 to 3,500 yards, and in about an hour it had traveled about 35 miles, finally disappearing about 4 miles northeast of the town of Woodston, in the same county. As the approach of the storm could be seen, people sought refuge in caves and cellars, and there was no loss of life. A terrific hailstorm preceded the tornado. At one place the hailstones were 2 inches deep on the level and in another they drifted to the depth of 18 inches, damming the lister rows in recently planted cornfields sufficiently to prevent damage by washing.

It was stated by an eyewitness that the storm center "had the appearance of an immense cone with a diameter of almost 2 miles. At times as many as three funnels would form and then unite into one. While the storm divided the damage was not great, but when the funnels united the effect was terrible."

The detailed statements regarding this storm and those to follow were taken mainly from the special reports of the section directors of the Weather Bureau.

The Kansas storms of May 25.

On the morning of May 25, the third of the series of depressions were central over eastern Colorado, with showers to the eastward and southeastward and a considerable rise in temperature in the Gulf States. Although the usual thunderstorm conditions were present, there were no indications of violent storms in any locality, Relative humidities were high, as afterwards ascertained, 94 per cent at Wichita, Kans., 95 per cent at Oklahoma City, 90 per cent at Little Rock, Ark., 96 per cent at Springfield, Mo., and 94 per cent at Memphis, Tenn, but as the weather was showery these high humidities were without special significance.

The first storm of the day was reported from Decatur County, Kans., at 1 p. m., and it appears to have moved from a point 8 miles northwest of the town of Jennings, to about 10 miles southeast of the town of Oberlin, a distance of about 10 miles in a northwesterly direction. The width of the path varied from 20 to 40 rods and but little damage was done. There was no loss of life.

From its direction of movement this storm could not have been a tornado, but was most likely a direct wind from between northeast and northwest.

About 3 p. m. two small storms formed near Sylvan Grove, in the western portion of Lincoln County, Kans. One was north and the other southeast of the town and both moved in a northeasterly direction. No lives were lost, and the damage was slight. No further details as to the storm were received.

The most destructive storm of the day occurred about the middle of the afternoon. It formed about 2 p. m., 3½ miles northwest of the town of Cheney, near the western edge of Sedgwick County, Kans., passed eastward through Sedgwick and Harvey Counties, and a portion of Butler County, into southeastern Marion County. The total length of the path was about 65 miles, while its width varied from a few rods to more than a mile—about three-fourths of a mile at Andale and about 1¼ miles at Sedgwick, both in Sedgwick County. The storm traveled about 40 miles in the 45 or 50 minutes.

Quoting from the report of Mr. S. P. Peterson, in charge of the Weather Bureau office at Wichita—

The funnel cloud attending the storm was plainly seen near Cheney, near which the storm had its inception. Here it was formed after a rushing together of the clouds, and was suspended, swinging from the main clouds like an elephant's trunk. Seven miles southwest of Andale it had assumed a dumb-bell shape. At Andale, Sedgwick, and a few miles southeast of Peabody, it seems the true funnel was not observed, but rather a dark storm mass, extending down to the ground, probably being half a mile wide at times. Near Florence two trailing pendants were seen at successive intervals.

Twenty-three persons were reported killed by the storm, 12 at Andale, where the local damage was also at its greatest. The total losses were $600,000. Over 100 farmsteads, residences, and business houses were either destroyed or damaged, trees were stripped of their foliage and bark and hundreds were uprooted or broken off. Considerable damage was done also to crops and live stock.

About 6:30 p. m. the last Kansas storm of the day formed about 4 miles west of Howard, Elk County. Without touching the town of Howard it moved northeastward across the southeastern corner of Greenwood County, and thence nearly due eastward across the adjacent sections of Woodson and Wilson Counties to the south central portion of Allen County, where it disappeared near the little town of Leanna. The total length of the path was about 58 miles and its average width one-fourth of a mile. The time consumed by the storm in traveling the 58 miles was apparently about 25 minutes. No funnel-shaped cloud was reported. But one life was lost in this storm, while the damage to farmhouses, barns, live stock, telephone lines, etc., amounted to about $50,000.

During the night of May 25–26 the Colorado disturbance of the previous day moved from Kansas to northwestern Iowa, with a further increase in intensity and with a considerable rise in temperature to the eastward and southward. Relative humidities at 8 a. m., May 26, were high as a rule, but at the same time the weather was cloudy and showery over the great Central valleys, so that the high humidity was without special significance. However, the general aspect of the weather chart was more threatening than on the previous morning.

The Illinois and Indiana tornadoes and windstorms of May 26.

There were two distinct storms, one over the northern and the other over the central portions of the States of Illinois and Indiana. The northern storm, by far the lesser of the two in every way, occurred between 3:10 and 5:56 p. m. It formed in the vicinity of Mendota, La Salle County, Ill., at 3:10 p. m., moved across Kendall and Will Counties to the Indiana boundary, thence across Lake County and much of Porter County, Ind., where it disappeared in the vicinity of Kouts at 5:56 p. m., having traveled 110 miles in 2 hours and 46 minutes, or at the rate of 40 miles an hour. The width of the track varied from one-half mile to 3 miles, but no funnel-shaped cloud was clearly defined. However, there were many of the usual evidences of tornadic action, three lives were lost in Illinois and four in Indiana, while the property loss was about $1,250,000.

Mattoon tornado.—The central storm, which was the most pronounced and destructive of the series, was first observed at noon in the shape of a tornado cloud at Pleasant Hill, about 7 miles from the Mississippi River. From this point it moved almost directly eastward across the counties of Pike, Greene, Macoupin, Montgomery, Christian, Shelby, and Coles as far as Charleston, where it turned a little to the southeastward and then continued to the Indiana line, afterwards crossing the southern portions of the Indiana counties of Vigo, Monroe, Bar-

tholomew, and the northern and central portions of Jennings County, disappearing near the east line of the latter county at 7:20 p. m. The total length of the path was about 300 miles and the average hourly rate of progression of the storm was 40 miles, the same as that of the northern storm. The average width of the path was about one-half mile, but where the damage was greatest the width was only about one-fourth mile. The storm lifted at times, causing little damage to some places in its path. There was a number of witnesses to a funnel cloud with a swinging tail, that appeared to persist almost as far as Mattoon, and also east of Charleston, but none between Mattoon and Charleston, a distance of about 10 miles, and covering the area of greatest destructive effect. However, there were plenty of convincing evidences of tornadic action over this 10 miles of territory, with a very low and very black cloud mass, and, as suggested by Mr. Root, of the Weather Bureau office at Springfield, the cloud may have been so close to the earth that there was no room for the pendant.

One hundred and one lives were lost during the storm and the property loss amounted to $2,200,000, exclusive of crop losses in the State of Indiana. It appeared that no lives were lost in central Indiana.

A detailed account of the storm will be found in the monthly report of Climatological Data (Illinois section), for May, 1917, which was compiled by Section Director Clarence J. Root, who personally visited the central Illinois district immediately after the storm. It is regretted that want of space prevents the reproduction of more than two of the photographs furnished (figs. 2 and 3). Another interesting account of the tornado by Prof. J. P. Carey, of the Eastern Illinois Normal School at Charleston, will be found in Science for June 15, 1917.

At 8 p. m., May 26, the disturbance that had caused the storm, was centered over Illinois with diminishing intensity, but another of the same general type was centered over the Texas Panhandle. On the morning of May 27 it was over Oklahoma with cloudy weather and moderate temperatures to the eastward and southward, the isobaric and isothermal arrangement indicating an excellent thunderstorm type, but less threatening than that area of the preceding storm.

Storms of May 27 in Arkansas, Tennessee, Kentucky, southern Illinois, northern Mississippi, and Alabama.

Arkansas and Kentucky.—The first severe storm of the day occurred in Mississippi County, in extreme northeastern Arkansas. There were two storms, one forming about 3 p. m. near Archillion, and the other about 4:30 p. m. near Manila. The latter storm moved northeastward over Big Lake, where it disappeared after a journey of only a few miles. The width of the path of greatest destruction was about one-fourth of a mile, and six persons were killed, with a property loss of about $12,500.

The first storm moved northeastward in an irregular course and soon came to the Mississippi River, about 15 miles distant. The rate of progression was slow, and the width of the path varied from one-eighth to one-fourth of a mile. Twelve persons were killed, and the property loss was about $43,000. This storm crossed the Mississippi River apparently quite close to and a little north of the town of Tomato, Ark., and then divided into two storms, one moving almost directly north-northeastward along the left bank of the river, crossing the Tennessee-Kentucky line into Fulton County, Ky., thence through Hickman and Carlisle Counties and the northern portion of Graves County to about the McCracken County line. It is reported that during its passage along the Mississippi River the storm caused a wave or wall of water that appeared to be about 40 feet in height.

The total length of the path of this storm was about 105 miles, of which 90 miles were east of the Mississippi River. The rate of travel from Archillion, Ark., to Hickman, Ky., was about 45 miles an hour. No details as to exact times of occurrence were received from points beyond Hickman, except that the storm passed to the northwest of Mayfield, in Graves County, between 5 and 6 p. m., indicating that the rate of 45 miles an hour was sustained throughout the life of the storm. The width of the path varied from about 100 yards to about one-half mile, least in the vicinity of Clinton in Hickman County.

The funnel-shaped cloud was reported generally in Fulton, Hickman, and Carlisle Counties, Ky., and at Hickman it was said to have resembled a large hornet's nest or balloon. About 60 persons were killed, while the damage amounted to more than $1,000,000.

Tennessee.—The storms in western Tennessee were apparently redevelopments, or offshoots, of the original storm that began about 3 p. m., near Archillion, Ark., and they were four in number. The first one occurred about 4 p. m. in the northwest corner of Lake County, on the Mississippi River, the same storm that devastated the extreme western counties of Kentucky, and two persons were killed, with property damage amounting to $10,000.

The second storm was also an offshoot from the Arkansas storm, and it was first observed near Unionville, 8 miles west-southwest of Dyersburg. The storm reached South Dyersburg about 4 p. m., moving in an east-northeast direction, passing a mile or two south of Sharon, in Weakley County, about 4:30 p. m., and disappeared in the northwestern portion of Henry County. The length of the storm path within the State of Tennessee was about 80 miles, or about 95 miles from the point of origin in Arkansas. The rate of progression of the storm between South Dyersburg, in Dyer County, and Ore Spring, in Weakley County, was about 48 miles an hour, and this was approximately the rate for the entire storm, as it consumed about two hours from start to finish. The average width of the track was one-half mile. Eleven persons were killed by the storm, and the property loss and damage amounted to more than $125,000. Near South Dyersburg a tract of timber valued at $10,000 was almost a total ruin.

The third storm was first noted at 4 p. m. at Trenton, Gibson County, coming from the west, and not far to the southeastward of the second storm, whose course it paralleled. Apparently this storm was also an offshoot from the parent Arkansas storm. The storm track was about 90 miles in length within the State of Tennessee, about 10 miles longer than that of the second storm. No details as to time of occurrence and width of track have been reported other than the time of occurrence at Trenton. Four persons were killed, and the property loss and damage amounted to more than $50,000.

The fourth storm was first observed about 6 p. m. at Finger, in the extreme northern portion of McNairy County. It moved in a northeasterly direction through the southeastern portion of Henderson County, reaching the town of Linden, in Perry County, about 7 p. m., or at the rate of 45 miles an hour. Between Perry and Davidson Counties there were no reports of severe storms, and,

[Facing p. 294.]

FIG. 2.—View at Mattoon, Ill. showing clearly defined track of complete destruction made by the tornado of May 26, 1917.

[Facing p. 294.]

FIG. 3.—View at Mattoon, Ill. after tornado of May 26 1917. Taken near the background of Fig 2, and at the side of the track there shown. (Arrows indicate same chimney in both views.

as stated by Mr. Roscoe Nunn, of the Weather Bureau office at Nashville, Tenn., the storm was temporarily deflected. Mr. Nunn says:

> It is probable that after passing Linden it (the storm) was deflected upward by the Western Highland Rim, which extends in a north-south direction across Hickman and Lewis Counties. This is assumed from the fact that it was not so violent in these counties, but became more destructive on reaching the eastern part of Davidson County, where it seemed to come to the earth again, passing just north of Brentwood in an east-northeasterly direction through Bakerton and Una, thence through Dodoburg and Lebanon, Wilson County.

The total length of the storm path was about 140 miles, and the time of travel from Finger to Lebanon 2 hours and 45 minutes, or at the rate of 50 miles an hour.

The first section of the fourth storm resulted in five deaths and property loss to the amount of about $35,000. The second section killed two persons, while the property loss amounted to more than $200,000. At Dodoburg a large poplar grove, valued at $30,000, was destroyed.

No funnel-shaped clouds were reported from any of these four Tennessee storms, although it was stated that wherever any great damage was done the characteristic tornadic phenomena were in evidence. When the third storm passed over Trezevant, Carroll County, at 5 p. m., it was reported that the sun was shining, with the main cloud not more than 150 feet in height, and there was no rain. During the progress of the fourth storm the home of Miss Maggie Moran at Una, Davidson County, was wrecked, and Miss Moran has written that—

> The door was blown open; I tried to shut it, but couldn't, and about that time the roof and north wall were blown northward and I was hurled to the floor; only a second, and the wind turned and blew the rest of the kitchen away, and I was blown 15 feet from the kitchen in a southwesterly direction. One foot was caught between two logs, which were supposed to come from a tree which was blown down near me; the shoe on the other foot has never been found.

Illinois.—The southern Illinois storms of May 27 appear to have been local ones, yet they were doubtless caused by the operation of the same general conditions that caused those to the southward. At 8 p. m. the principal cyclonic center was over southeastern Missouri, indicating that at about 5 p. m., when the southern Illinois storms began, it was central over south-central Missouri, bringing the storm section on its east-southeastern edge. The storm was first observed at 5 p. m., a few miles east of Chester, Randolph County, where it blew down buildings and killed one man. It first moved a little north of east, and at 5:40 p. m. struck the town of Willisville in true tornadic form, with a funnel-shaped cloud. Thereafter the path was a little to the south of east and about 6:30 p. m. there was also some damage at Hallidayboro, in the northern portion of Jackson County. The total length of the path was thus about 30 miles, and the damage amounted to something more than $80,000.

Mississippi.—The storms in Mississippi were not of a very violent character, although at some places reaching the proportions of a true tornado. No lives were lost, and the damage amounted to about $20,000. Except in Pontotoc County, there were evidently nothing more than "straight-line" winds. In Pontotoc County, as reported by Dr. C. W. Bolton, cooperative observer at the town of Pontotoc, there was "a very black cloud, like smoke from a burning sedge field, blowing along the ground, as if boiling. Trees in the center of the path were blown eastward, but on either side toward the center." The postmaster at Sherman, in the northeastern corner of Pontotoc County, reported a funnel cloud, with the direction of the fallen trees north and south of the path the same as at Pontotoc, while at the center there were as many as 12 trees with their tops together.

The storm began about 5 p. m., one hour later than the third Tennessee storm, first appearing near Grenada, in Grenada County. There was "a heavy cloud, but not a well-defined funnel, and the wind was rather straight to the east." The storm moved northeastward, apparently lifting as it passed over Calhoun County, but descending again in Pontotoc County, which it crossed from southwest to northeast, and then disappeared. The length of the track was about 65 miles, while the width varied from 100 yards at starting to one-half mile at the east end of Pontotoc County where it was lost.

Alabama.—The Alabama storms were among the most destructive of the series, and in respect to loss of life they were exceeded only by those of Illinois and Kentucky. The most severe storms occurred in western Walker, northern Jefferson, southern Blount, southeastern Talladega, and southeastern Madison Counties, and they were most destructive in northern Jefferson, where whole mining towns were wiped out. There were also storms of lesser violence in portions of Lauderdale, Franklin, Tuscaloosa, Bibb, Shelby, Etowah, Marshall, and Jackson Counties, all in the northern portion of the State. In all 40 persons were killed, while the losses and damage amounted to more than $430,000.

At 8:45 p. m., a storm moving from southwest toward northeast struck the town of Carbon Hill, in western Walker County. It was accompanied by a funnel-shaped cloud, and cut a path about three blocks wide. Felled trees on the north side of the path pointed toward the southeast, and those in the center and on the south side toward the northeast. Five persons were killed, and the damage amounted to about $200,000. In a short time the storm had moved eastward across Walker County to the northern portion of the adjoining county of Jefferson, or perhaps it would be more exact to say that another storm struck the town of Sayre, in northwestern Jefferson County, at the same time that the Carbon Hill storm occurred. The direction of movement was the same and there was a funnel cloud. The path was about one-half mile in width, and felled trees lay in all directions. The town was obliterated, and nine persons lost their lives, with a property loss amounting to about $65,000. The neighboring town of Bradford was also visited, and 17 negroes were reported killed.

At 9:20 p. m. the little mining town of Majestic, in north Jefferson County, was destroyed. There were no details given, except that there was very little rain. No lives were lost. At the same time the storm reached Village Springs, Blount County, a little to the northeast of Sayre, with the funnel cloud still present. The arrangement of felled trees again indicated the true tornado, those in the center lying with their tops toward the east. A negro infant was killed, while the property loss amounted to about $40,000.

The town of Sylacauga, in southeastern Talladega County, was struck at 12:45 a. m., May 28. There was a well-defined pendant, funnel cloud, and the width of the path was somewhat more than 1 mile. One negro man was killed, and the property loss amounted to about $125,000.

In the town of New Hope, in southeastern Madison County, six persons were killed. No other details were available. The storm also crossed a portion of Tuscaloosa County into Bibb County, and one person was killed at Bibbville, in the latter county.

Details as to the storm conditions in the other counties mentioned were not received.

The Missouri storms of May 30.

On the morning of May 30 another of the series of southwestern disturbances was central over Kansas and Oklahoma, with moderately high pressure and quite low temperatures over the Northwest, and with moderately high temperatures to the southward and southeastward, the surface inversion extending up into the upper Mississippi Valley. General thunderstorms had occurred over the region of the higher temperatures, but conditions were not decidedly abnormal except as to the northwestern low temperatures.

The details received regarding the local storms of the day were very meager, except for the eastern portion of Washington County, but it appears that the first storm was seen in the early afternoon in the vicinity of Houston, Texas County, and that it moved in a northeast-east direction across Dent County, the northern portion of Iron County, and the central and northern portions of Washington and St. François Counties, a distance of perhaps 80 miles. Mineral Point, in Washington County, apparently near the end of the track and the seat of the greatest destruction, was reached at 3 p. m. A funnel cloud was observed here, and the storm lasted about five minutes. Fifteen persons were killed at various places within the storm area, and the property loss probably amounted to more than $500,000, of which about $400,000 was incurred in Mineral Point and vicinity.

Another severe storm occurred in the late afternoon a little farther to the southeastward, originating apparently in the southwestern portion of Wayne County. It moved eastward across the southern portions of Bollinger and Cape Girardeau Counties, and the northern portions of Stoddard and Scott Counties, crossed the Mississippi River a short distance above Cairo, Ill., and passed over the northern portion of Alexander County during the early evening, covering in all a distance of about 85 miles. Here again details are wanting, but press reports stated that 25 persons were killed and much property damaged.

A storm also struck portions of Bates County in the extreme west-central portion of the State during the early morning, doing considerable local damage. It appears from this that the general storm condition consumed a period of about 12 hours in traversing the State from west to east, keeping well to the southeastward of the center of the main barometric disturbance, which at 8 p. m. was over Iowa and northern Missouri.

Storms of May 31–June 1 in Oklahoma and Kansas.

Oklahoma.—On the evening of May 31 the next of the series of southwestern disturbances was central over western Texas, with high pressure, low temperatures, and sharp temperature gradients to the northward, with cloudy weather, and with high temperatures to the southward and southeastward with generally clear weather. The conditions were decidedly unstable and late at night a severe storm broke over Pitman, Love County, Okla., and probably extended eastward over Marshall County, as it was reported at 9 p. m. at Durant in the western portion of Bryan County, where it did considerable damage. Three persons were killed at Pitman, and the general property damage amounted to more than $50,000. The length of the storm track was about 50 miles, and there were some evidences of true tornadic action.

On the morning of June 1 the general disturbance was central over southwestern Oklahoma, with continued high pressure and low temperatures to the northward, and warm, showery weather to the eastward and southward. Conditions were still very unstable and during the day a series of severe storms occurred over various portions of east-central Oklahoma. They began about 2 p. m. in Logan County, and also visited portions of Murray, Seminole, Creek, and Okmulgee Counties, reaching the latter late in the day and destroying 42 oil derricks. Twenty-five derricks were also destroyed in the northwestern portion of Creek County.

In Logan County there were five small tornadoes between 2 and 3 p. m., but their approach was easily visible, and no person was killed or injured. Damage was mainly confined to crops.

Another of the tornadoes visited the town of Drake, in Murray County, at 3:15 p. m., killing 5 persons and doing much damage. This storm moved a little north of eastward and shortly after 4 p. m. struck the town of Coalgate, in Coal County, where it caused the death of 5 persons and ruined property to the value of $500,000. This storm evidently dissipated a short distance east of Coalgate, and the length of the path was about 50 miles. No funnel cloud was observed, but there were many evidences of decided tornadic action, especially at Coalgate, where a "twisting pillar of cloud," about 3 miles in height and ending in a cloud of greenish tint, passed through the western end of the town. The width of the path of the storm from Drake to Coalgate varied from 40 to 150 yards.

In the late afternoon another storm struck the northern portion of Seminole County, doing considerable damage.

Kansas.—The storm field also extended over the Oklahoma-Kansas line, and at 5:30 p. m. the city of Coffeyville, Kans., experienced a storm that tore a path about one block in width through the city. Three persons were reported killed and the property loss amounted to $150,000.

Still another storm visited Franklin and Johnson Counties, Kans., beginning about 6:30 p. m., and three persons were killed near Morse, about 5 miles southeast of Olathe. The storm path was about 200 feet in width and it extended eastward a few miles to the town of Stanley, thence northeastward across the Kansas-Missouri line, where very heavy rains occurred. There was no funnel cloud reported, although there were some slight evidences of tornadic action. The loss and damage amounted to about $10,000.

It was reported also that severe storms had occurred over portions of Greene, Dallas, and Laclede Counties in southwestern Missouri, but no details were available.

Kansas and Missouri storms of June 5.

On the morning of June 5 still another of the southwestern series of storms was over south-central Kansas with an apparent northeastward movement. There was no high pressure to the northward and temperatures had risen over that section. To the eastward and southward there had been heavy showers from the preceding disturbance, while to the southward and southeastward the weather was clear and moderately warm. Conditions were really less threatening than during any of the preceding storms of the series, except that the disturbance was increasing in intensity with its northeastward movement, evidences of a still further increase which was strongly in evidence at 8 p. m. when the storm center was very close to Kansas City, Mo.

Kansas.—The tornado first appeared as a terrific hailstorm at Eskridge, in the southeastern portion of Wa-

baunsee County, Kans., and some of the hailstones were reported to have been more than 3 inches in diameter, actually doing more damage than the tornado that followed a few minutes later. The storm moved eastward across Shawnee County, striking the towns of Valencia, Maple Hill, and Elmont, completely demolishing the latter, but fortunately without loss of life. It was said that the storm lifted and descended several times, and at 5:30 p. m. it reached to within 3 miles of Lawrence, in Douglas County, en route passing through the town of Clinton, 12 miles to the westward, where it killed one man. A section of Jefferson County was also visited. Thus far the length of the storm path was about 50 miles and its width about 1 mile. No funnel cloud was seen, but there were the huge black tornado clouds that gave warning of the approach of the storm. Six persons were killed, while the damage to property and crops was estimated at more than $1,000,000, making the storm by far the most destructive one of the year.

It happened also that at 6 p. m. there was a local tornado 1 mile from Savonburg, in the southeastern portion of Allen County, some 80 miles south of Lawrence. The storm came from the southwest, moved in a northeasterly direction, and evidently soon dissipated. One woman was killed, and the damage to farm buildings, crops, and other property was very extensive.

Missouri.—The northern storm appeared to lose much of its intensity after leaving Douglas County, and, for a time, left no traces, but it apparently crossed the Missouri River just above Kansas City, for in a few hours it appeared in the southern portion of Ray County, Mo., whence it moved northeastward across Carroll County, virtually wrecking the town of Deer Lake at 9 p. m. In the county of Chariton, adjoining to the eastward, the town of Whitham was demolished. After leaving Chariton County, the storm turned to the southeastward, following the general course of the Missouri River. Howard County was passed without much damage, but Boone County was not so fortunate, as there was a redevelopment of a destructive character. The towns of Centralia and New Providence specially suffered, 7 persons losing their lives at the former place.

The length of the active storm path in the State of Missouri from Ray to Boone Counties was about 110 miles, while the distance from the region of cessation from violent storm activity in Kansas to that of its resumption in Missouri was about 65 miles, making the total length of the path about 225 miles. The width of the path within the State of Missouri varied from 50 to 500 feet, and in all 14 persons lost their lives, while the property loss was probably $200,000, of which $100,000 fell upon Boone County.

The usual black clouds were seen, but without the funnel shape. Judging from its behavior, the storm was certainly a tornado. A small iron bridge was carried about 2,000 feet and deposited in a wheat field, a cemetery was swept clear of tombstones, and fields of wheat and corn were swept bare.

There was also a local storm about the same time in the southeastern portion of the Wright County apple belt. No details were received, but press dispatches stated that 7 persons were killed and much damage done.

The Michigan and Kentucky storms of June 6.

During the early afternoon hours of June 6 destructive tornadoes visited several counties in the southern portion of the State of Michigan, killing 3 persons, fatally injuring 5 others, and doing damage to the extent of $1,500,000, one-third of which occurred in the city of Battle Creek, and another third in Washtenaw County. Published details were very meager as to the behavior of the storm, but quite elaborate as to injuries and damage. More complete information will probably be found in the Report of Climatological Data for Michigan for June, 1917.

The weather map at 8 a. m. showed the southwestern disturbance of the previous day to be central over northern Iowa, still moving northeastward with greatly increased intensity (29.12 inches at Charles City, Iowa), accompanied by moderately high pressure and high temperatures on the southeast, and a strong temperature inversion extending northward to southern Lake Michigan. Heavy thunderstorms had occurred in the great Central valleys, the southern Upper Lakes and the western Lower Lakes regions, and on the previous evening there had been tornadoes in eastern Kansas and central Missouri.

Michigan.—The first evidences of unusual storm conditions were noted on Lake Michigan, near Grand Haven, shortly after noon when the crew of the tug *Robert Johnston* saw a waterspout form far out on the lake and sweep toward shore. Fishermen had previously reported the weather out on the lake as very squally. The spout struck the shore hills several miles south of Grand Haven, and as the storm passed inland it developed tornado strength and characteristics, moving to the middle sections of Ottawa County and causing considerable damage to farmhouses and other farm property. About the same time the principal storm of the day first appeared near the town of Climax in the extreme east-central portion of Kalamazoo County. It moved northeastward, soon reaching the city of Battle Creek, Calhoun County, where 28 houses were wrecked and 50 others badly damaged, although no loss of life occurred. After leaving Battle Creek the storm traveled eastward, reaching the town of Springport, Jackson County, about 12:30 p. m. "with a noise like a train coming." Here one person was killed and property destroyed or damaged to the extent of $100,000. The storm continued through the northern portions of Jackson and Washtenaw Counties with undiminished violence, wrecking nearly everything in its path, especially in the extreme northeastern portion of Washtenaw County where 2 people were killed near the town of Salem. Passing into Oakland County, the storm was lost on the waters of Cass Lake after having traversed a path about 105 miles in length. The average width of the path was about one-fourth of a mile, although it is said to have been much less in Battle Creek. The rate of progression was about 40 miles an hour.

Funnel-shaped clouds "twisting back and forth" were reported at different places along the course and also "many black clouds, like smoke," indicating that the storm cloud was very close to the earth. Press accounts of damage also indicated the true tornadic character of the storm.

Kentucky.—During the same afternoon a local storm occurred at the mining town of Bevier, Muhlenberg County, Ky., killing 5 persons and destroying considerable property. The storm moved in a southeasterly direction and crossed Green River a short distance above the town of Rochester, after which it was lost. The crossing of Green River was witnessed by the passengers and crew of the steamboat *Bowling Green*, who reported logs and portions of trees flying through the air. Other reports stated that some trees were blown down and the tops of others twisted off and blown away.

Summary of losses by tornadoes, etc., May and June, 1917.

The losses of life and property follow in tabulated form, by States.

State.	Date.	Lives.	Property.
Kansas	May 20	24	$650,000
Northern Illinois	May 26	1	800,000
Northern Indiana	do	6	400,000
Central Illinois	do	101	2,200,000
Central Indiana	do		300,000
Arkansas	May 27	18	55,500
Kentucky	do	60	1,000,000
Tennessee	do	24	420,000
Alabama	do	40	430,000
Mississippi	do		20,000
Missouri	May 30	40	500,000
Oklahoma	May 31-June 1	8	550,000
Kansas	June 1	6	160,000
Kansas	June 5	8	1,000,000
Missouri	do	14	200,000
Michigan	June 6	5	1,500,000
Kentucky	do	5	
Total		360	10,185,000

While these storms of 17 days were quite numerous, it does not appear that occurrences of this character are increasing in number as a whole, nor is there any special region of greatest frequency. The whole question is one of the occurrence of the contributing distribution of pressure, temperature, and moisture, and certainly the observation and experience of the past do not warrant the conclusion that any one *limited* area more than another within the severe storm field is more subject to the requisite distribution of the formative causes. It can also be said with reference to increasing frequency that the storms are not more numerous than heretofore; but as former sparsely settled districts become more densely populated and facilities for intercommunication become multiplied, the details of the storms are made available more rapidly and losses of life and property increase, because there are more of both exposed to the fury of these unpreventable storms.[2]

METEOROLOGICAL COURSES FOR AERONAUTICAL ENGINEERS.

The National Advisory Committee for Aeronautics, cooperating with the United States War Department, arranged in May, 1917, with a number of leading universities and schools, for courses designed to specially further the education and training of aviators. These courses, technically known as "Ground Schools in Military Aeronautics," include such subjects as elementary meteorology, astronomy, engineering, internal-combustion engines, etc., and they are now being offered at the following institutions: Massachusetts Institute of Technology in cooperation with Harvard University (Cambridge, Mass.), Princeton University (Princeton, N. J.), Cornell University (Ithaca, N. Y.), Ohio State University, (Columbus, Ohio), University of Illinois (Champaign, Ill.), University of Texas (Austin, Tex.), University of California (Berkeley, Cal.).

Prof. Robert De C. Ward is giving the course in meteorology at the Massachusetts Institute of Technology, and also a more extended course forming part of the requirements leading to the degree of aeronautical engineer. He has kindly communicated the syllabus of the longer course and permits us to publish it here, as it is sure to prove helpful and stimulating to others who may have similar tasks assigned them.—*Chief of Bureau.*

[2] For an article on tornado insurance, which discusses frequency in the several States up to and including 1896, see this REVIEW for December, 1905, 33:534-539; see also Flora in this REVIEW, December, 1915, 43:615-616, for statistics on Kansas, including 1915.—C. A., jr.

SYLLABUS OF LECTURES ON METEOROLOGY GIVEN IN THE COURSE IN AERONAUTICAL ENGINEERING AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY IN COOPERATION WITH HARVARD UNIVERSITY.

I.

Ten lectures by Robert De C. Ward, Professor of Climatology, Harvard University.

Introductory.—Importance of meteorology in aviation; aircraft and weather in war:

(*a*) General climate.

(*b*) Weather and weather forecasts; military field meteorological services.

The atmosphere.—Composition; height; "troposphere" and "stratosphere"—general characteristics of each.

Temperatures in the free air.—Vertical temperature gradients; temperatures at various heights; inversions; stable and unstable conditions in relation to flying.

Pressure.—Importance; comparison with water; decrease with altitude; physiological effects of diminished pressure; measurement; mercurial and aneroid barometers and barographs: use, errors, corrections; determination of altitudes by means of barometers; isobars; pressure gradients.

The wind in relation to pressure at earth's surface.—Wind direction; deflection of winds from gradient; Earth's rotation and friction; cyclonic and anticyclonic wind systems; "Gradient wind"; Buys Ballot's Law; isobaric types.—Wind velocity; general relation to gradient; Beaufort Scale and its equivalents in force and in velocity in miles an hour; anemometers: Robinson and Dines; gustiness of wind.

Conditions of the atmosphere affecting aviation.—General and local.—(*a*) General air movements, essentially horizontal; atmospheric layers and waves. (*b*) Local convectional currents, essentially vertical, due to thermal controls: causes and conditions. (*c*) Effects of topography upon air movements, combining both horizontal and vertical elements, due to mechanical controls: effects of friction, topography, and character of surface; vertical and horizontal movements in general in relation to flight.

Weather forecasting.—Explanation of daily weather map; principles of forecasting explained by reference to type maps, for United States and for Europe; general characteristics of cyclones and anticyclones; tracks; velocities of progression.

Noninstrumental local forecasts.—Barometric tendency; veering and backing winds; changes in wind velocity; weather proverbs.

Clouds.—Types; cloud classification; methods of determining cloud heights and velocities, and results; value as weather prognostics; fair and wet weather clouds; fog; special consideration of cumulus and cumulo-nimbus.

Forecasts of wind velocity and direction aloft.—Direct observation by means of pilot balloons, kites, and cloud movements; directions of cloud movements in cyclonic and anticyclonic systems in the United States and in Europe; estimates based on surface conditions and on general knowledge of upper air currents; "Gradient wind"; diurnal variation in wind velocity and direction; changes due to progression of cyclones and anticyclones; wind and cloud directions and night flying.

Favorable and unfavorable weather for flying.—Wind; clouds; haze, etc.

II.

Laboratory Work at Blue Hill Observatory (10 hours). Alexander G. McAdie, Abbott Lawrence Rotch Professor of Meteorology, Harvard University, and Director of the Blue Hill Meteorological Observatory, Readville, Mass.

SOME RESEARCHES IN THE FAR EASTERN SEASONAL CORRELATIONS.

(THIRD NOTE.)[1]

By T. OKADA.

[Dated: Central Meteorological Observatory, Tokyo, June 1, 1917.]

[Abstract by the Editor from the Journal of the Royal Meteorological Society of Japan, June 1917, 36: 55-63.]

1. *Correlation between the April pressure in southeastern Canada and the August temperature in northern Japan.*—A remarkable parallelism is traced between the variation of the barometric pressure at Toronto in April and the variation of the temperature at Erimo in the following August. The April pressures for Toronto, 1887 to 1914, and the Erimo temperatures for August for the same interval, show that 21 out of 27 variations of the August temperatures at Erimo are in the same sense as those of the April barometric pressures at Toronto, while only 6 are of conflicting signs. Hence the probability that the signs will be similar is 78 per cent as against 22 per cent that they will be in opposition. It is concluded that *a rise of pressure in southeastern Canada in April appears to be followed by a rise of temperature on the east coast of northern Japan in August*, and vice versa.

The same data presented graphically, strikingly confirm the deduction; but when the correlation coefficient is deducted it appears that $r = +0.32 \pm 0.114$, a value that is unduly small. This is explained, perhaps, by the fact that the variation under consideration is superposed upon a secular variation. It is also here pointed out that a similar parallelism exists between the April pressures at Montreal and elsewhere in eastern Canada and the August temperature in northern Japan.

2. *Correlation between the April pressure in the Azores and the August temperature in northern Japan.*—Comparisons between the April pressure at Ponta Delgada, Azores, from 1879 to 1912, with temperatures in August at four stations in northern Japan for about the same period, show a fairly established parallelism. The probability of the variation of the August air temperature at the four localities in Japan, in the same sense as that of the April pressure at Ponta Delgada is shown in the following Table 1.

TABLE 1.—*August temperature in northern Japan and April pressure at Ponta Delgada.*

Sign.	Nemuro.	Erimo.	Miyako.	Isino-maki.
Cases with the same	24	19	21	18
Cases with the opposite	9	6	8	6
Number of cases	33	25	29	24
Probability of the same sign.....per cent..	76	76	72	75
Probability of the opposite sign.....do....	24	24	28	25

The coordinates of three places are given in the MONTHLY WEATHER REVIEW, January, 1916, page 18, but Erimo lies in latitude 42° N., longitude 143° 15′ E. Graphic construction confirms the parallelism generally, and it is concluded that *a rise of pressure at Ponta Delgada in April is followed by a rise in temperature in northern Japan in the following August*, and vice versa.

3. *Correlation between the April pressure in the Bermudas and the August temperature in northern Japan.*—Bermuda lies at the western extremity of the great Atlantic anticyclone, while the Azores lie at the opposite extremity. Any variation in intensity and position of the action-center is correspondingly revealed in the barometric data at either station. It is therefore no mere coincidence that one can trace a fairly established parallelism between the April pressure at Prospect, Bermuda, and the temperature of the following August in northern Japan. The corresponding records from 1896 to 1914 (Table 2 on p. 58, loc. cit.) bring this out. The probability of the variation of the August temperature at the various localities in northern Japan in the same sense as that of the April pressure at Prospect, Bermuda, is shown in the following Table 2.

TABLE 2.—*August temperature in northern Japan and April pressure at Prospect, Bermuda.*

Sign.	Nemuro.	Erimo.	Miyako.	Isino-maki.
Cases with the same	13	12	12	12
Cases with the opposite	6	7	7	7
Number of cases	19	19	19	19
Probability of the same sign.....per cent..	68	63	63	63
Probability of the opposite sign.....do....	32	37	37	37

4. *Correlation of the barometric pressures at Toronto in April and August.*—The correlation between eastern Canada and Japan, made above in paragraph 1, brought out a remarkable parallelism in the mean barometric pressures for Toronto in April and August during the years 1887–1914, inclusive.

5. *Correlation between the April pressure in Iceland and the temperature of the following August in northern Japan.*—Prof. von Hann has shown [2] that there exist remarkable contrasts between the pressure deviations at Ponta Delgada in the Azores and at Stykkisholm, Iceland. We have shown in the preceding paragraphs that there is parallelism between the April pressure at Ponta Delgada and the temperature of the following August at Nemuro, Hokkaido. It follows that there must be a marked contrast between the variations of the April pressure at Stykkisholm and the August temperature at Nemuro. This is clearly shown to exist by the data in Table 3 below. The pressure data for Stykkisholm have been taken from Dr. Lockyer's pressure table.[3] In the table s stands for the April pressure at Stykkisholm and δs for its inter-annual variation; w for the August temperature at Nemuro and δw for its inter-annual variation; p for the April pressure at Ponta Delgada.

TABLE 3.—*Correlation between the April pressure at Stykkisholm, Iceland (s), and the August temperature at Nemuro, Hokkaido (w), through the April pressure at Ponta Delgada, Azores (p).*

Year.	s	w	δs	δw	p	$p-s$	$\delta(p-s)$
	mm.	°*C.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
1879	756.6	17.1	.....	.....	764.9	8.3	.....
1880	51.6	20.5	−5.0	+3.4	65.6	14.0	+5.7
1881	758.0	16.9	+6.4	−3.6	760.9	2.9	−11.1
1882	60.7	19.8	+2.7	+2.9	64.7	4.0	+1.1
1883	50.6	19.9	−10.1	+0.1	64.9	14.3	+10.3
1884	56.5	16.4	+5.9	−3.5	59.8	3.3	−11.0
1885	53.7	16.9	−2.8	+0.5	66.7	13.0	+9.7
1886	755.8	19.8	+2.1	+2.9	761.5	5.7	−7.3
1887	60.6	18.8	+4.8	−1.0	59.1	−1.5	−7.2
1888	61.0	17.4	+0.4	−1.4	66.2	5.2	+6.7
1889	54.6	18.2	−6.4	+0.8	68.9	14.3	+9.1
1890	52.5	19.3	−2.1	+1.1	67.5	15.0	+0.7
1891	758.9	17.1	+6.2	−2.2	762.4	3.5	−11.5
1892	37.2	17.3	−1.7	+0.2	64.1	6.9	+3.4
1893	54.8	17.3	−2.4	0.0	62.7	7.9	+1.0
1894	52.6	17.8	−2.2	+0.5	66.6	14.0	+6.1
1895	56.0	15.8	+3.4	−2.0	62.0	6.0	−8.0
1896	752.6	17.7	−3.4	+1.9	768.7	16.1	+10.1
1897	46.5	17.0	−6.1	−0.7	67.4	20.9	+4.8
1898	48.7	16.4	+2.2	−0.6	65.1	16.4	−4.5
1899	59.1	15.4	+10.4	−1.0	65.4	6.3	−10.1
1900	54.6	18.2	−4.5	+2.8	65.3	10.7	+4.4
1901	752.0	17.9	−2.6	−0.3	764.8	12.8	+2.1
1902	59.3	14.5	+7.3	−3.4	61.1	1.8	−11.0
1903	57.4	15.9	−1.9	+1.4	64.7	7.3	+5.5
1904	47.7	18.5	−9.7	+2.6	69.6	21.9	+14.6
1905	.....	.....	.....	.....	.....	.....	.....

[1] For the previous Notes see this REVIEW, January, 1916, 44: 17-21, and May, 1917, 45: 238-240.

[2] *Hann, Julius von.* Die Anomalien der Witterung auf Island, u. s. w. Sitzungsb. Kaiserl. Akad. d. Wissens., mathem.-naturw. Kl., 1904, Bd. 113.

[3] *Grt. Britain. Solar Physics Committee.* Monthly mean values of barometric pressures for 73 selected stations over the earth's surface . . . Compiled . . . under direction of Sir Norman Lockyer. London, 1908. v, 97, etc., p. 4°.

From Table 3 we see that out of 25 cases in only 4 cases are δs and δw of the same sign (1882, 1886, 1897, 1901). Hence the probability of the contrary sense in the variations of the August temperature at Nemuro as compared with those of the April pressure at Stykkisholm is 84 per cent, and the probability of their having the same sign is 16 per cent. The author also presents this comparison in graphic form (his Fig. III).

5. *Correlation between the April barometric difference Azores–Iceland, and the August air temperature in northern Japan.*—Inspection of Table 3 shows further that there is a remarkable parallelism between the barometric difference or gradient between Azores and Iceland (p–s) in April and the temperature at Nemuro for the following August. Out of the 25 cases given there are 21 in which the signs of δw and $\delta(p$–$s)$ agree; hence the probability of parallelism is 84 per cent, and that of contrast is 16 per cent.—C. A., jr.

Kristian Birkeland, 1867-1917.

By C. CHREE.

[*Reprinted from* Nature, London, June 28, 1917, **99**: 349.]

We regret to learn from the [London] Morning Post that Prof. Kristian Birkeland, of Christiania, died in Tokyo on June 18, 1917. He was one of the few speculative physicists of the day the value of whose work would be generally admitted in commercial circles. He was the co-inventor with Mr. Sam Eyde of the Birkeland-Eyde direct process for the manufacture of calcium nitrate by the extraction of nitrogen from the atmosphere. In the Journal of the Royal Society of Arts, May, 1912, Mr. E. Kilburn Scott records how, starting with a 25-horsepower experimental plant in 1903, the company controlling the Birkeland-Eyde patents had 200,000 horsepower at work in 1912, and was likely to add a further 300,000 horsepower before the end of 1916. This was by no means the only successful patent in which Prof. Birkeland was interested.

As a theorist Prof. Birkeland was extraordinarily bold in his speculations. He had theories on the internal constitution of the sun and the nature of sun spots; on the sun as a magnet and as a source of electricity; [1] on the origin of the planets and their satellites; on the nature of various celestial phenomena, specially the zodiacal light; [1] on the production of auroræ and magnetic storms; [2] and on the past geological history of the earth. The wealth acquired by his practical gifts enabled Prof. Birkeland to experiment and to arrange for solar and magnetic observations on a large scale. He made many striking experiments with an artificially magnetized terella in a high vacuum, directing toward it electrical discharges intended to represent the discharge of corpuscles from the sun.[3] In some of his experiments the vacuum chamber had a capacity of 70 liters and the supply of electrical energy required a 6-horsepower engine. He obtained phenomena closely resembling various forms of aurora, phenomena which he believed to represent the conditions under which magnetic storms appear on the earth.

Prof. Birkeland was largely responsible for the institution of special magnetic observatories in Arctic regions in 1900, in 1902–3, and again during the last few years. His two large volumes in English, "The Norwegian Aurora Polaris Expedition, 1902–3," besides much speculation as to the causes of magnetic storms, contain much important information as to the simultaneous progress of magnetic disturbance at different parts of the earth.[4] Since 1910 he had lived a good deal abroad for observational purposes, and numerous communications to the Comptes Rendus of the French Academy of Sciences describe his various conclusions and speculations. In one communication dated July, 1914, he expressed his intention of devoting the next three years to the study of the zodiacal light in Natal, at Helwan, and in Uganda, and he was working in Egypt in 1915 and 1916. Presumably the continuation of his quest had taken him to the Far East. At the time of his death Prof. Birkeland was only about 50 years of age; but when last in England, in 1913, he had aged considerably in appearance and become very deaf. He was, however, as animated as ever when discussing his theories.

[1] This REVIEW, April, 1914, **42**: 209 (Abstract).
[2] This REVIEW, April, 1914, **42**: 211 (Quoted); see also footnote 3.
[3] Abstract of conclusions in this REVIEW, September, 1916, **44**: 508.

USE OF THE DIVINING ROD IN THE SEARCH FOR HIDDEN THINGS.

In the MONTHLY WEATHER REVIEW for March, 1900, the late Prof. Cleveland Abbe published a note drawing attention to the appointment of a French commission, presided over by the engineer Borthier de Rollière, to study all apparatus and methods employed by sorcerers, water seers, etc., who use the divining rod, exploring pendulum, hydroscopic compass, or other fancifully named device. The report of this commission was probably published in 1913, but seems not to have settled the question of the reliability of this kind of device, for it appears that many persons are still successfully persuading the public to employ it.

The literature on the subject of the divining rod is very extensive, and embraces works in one or the other of at least four modern or dead languages, beginning as early as 1532. This literature has recently been well searched and condensed into an interesting publication of the United States Geological Survey,[1] which may be recommended to all who ask, or have to answer, questions about the "discovery" of water, ores, minerals, etc., by occult means. The following is quoted from the introductory note by O. E. Meinzer:

> The use of a forked twig, or so-called divining rod, in locating minerals, finding hidden treasure, or detecting criminals is a curious superstition that has been a subject of discussion since the middle of the sixteenth century and still has a strong hold on the popular mind, even in this country, as is shown by the large number of inquiries received each year by the United States Geological Survey as to its efficacy, especially for locating underground water, and the persistent demands that it be made a subject of investigation by the Survey. The bibliography shows that a truly astonishing number of books and pamphlets have been written on the subject. * * * The outline of the history of the subject presented in the following pages will probably enable most honest inquirers to appreciate the practical uselessness of "water witching" and other applications of the divining rod, but those who wish to delve further into the mysteries of the subject are referred to the literature cited in the bibliography, in which they will find reports in painful detail of exhaustive investigations and pseudo-investigations of every phase of the subject and every imaginable explanation of the supposed phenomena.
>
> It is doubtful whether so much investigation and discussion have been bestowed on any other subject with such absolute lack of positive results. It is difficult to see how, for practical purposes, the entire matter could be more thoroughly discredited, and it should be obvious to everyone that further tests by the United States Geological Survey of this so-called "witching" for water, oil, or other minerals would be a misuse of public funds.
>
> A large number of more complicated devices for locating water or other minerals are closely related to the forked twig. A favorite trick for appealing to uneducated persons and yet making specific disproof

[4] This REVIEW, January, 1909, **37**: 16–18.
[1] *Ellis, Arthur J.* The divining rod, a history of water witching, with a bibliography [and introduction by O. E. Meinzer]. Washington, 1917. 59 p. 4 figs. 8°. (U. S. Geol. Surv. Water Supply Paper 416).

impossible is to give as the working principle of such a device some newly discovered and vaguely understoood phenomenon, as for example, radioactivity. Many such devices have been in existence since the seventeenth century, and almost without exception the claims that are made for them are very great. If any genuine instrument were invented, its merits would no doubt in time become well recognized, as have those of other real inventions. The magnetic needle used in detecting iron ore is, of course, not included in this category of spurious instruments.

It is by no means true that all persons using a forked twig or some other device for locating water or other minerals are intentional deceivers. Some of them are doubtless men of good character and benevolent intentions. However, as anything that can be deeply veiled in mystery affords a good opportunity for swindlers, there can be no reasonable doubt that many of the large group of professional finders of water, oil, or other minerals who take pay for their "services" or for the sale of their "instruments" are deliberately defrauding the people, and that the total amount of money they obtain is large.

To all inquiries the United States Geological Survey therefore gives the advice not to spend any money for the services of any "water witch" or for the use or purchase of any machine or instrument devised for locating underground water or other minerals.

DESICCATION OF AFRICA.

[Nature, London, June 28, 1917, 99: 352.]

The journal of the East Africa and Uganda Natural History Society (v. 6, no. 11) contains an interesting paper by R. L. Harger on the desiccation of Africa. Reviewing the records on this theme by pioneers like Livingstone, Harris, and Selous, the author adds much valuable matter of his own covering a vast extent of country from Tanganyika southward and westward. There can be no question [says the reviewer in Nature] that the diminution of the chain of the great lakes and the river systems feeding them is proceeding at a most disconcerting rate, but the author makes no suggestion as to the causes to which this shrinkage is due.

EFFECT OF HUMIDIFICATION OF A SCHOOL ROOM ON INTELLECTUAL PROGRESS OF THE PUPILS.

By EDWARD L. THORNDIKE and PAUL J. KRUSE.

(Columbia University, New York City, N. Y.)

[*Condensed from* Science, New York, June 2, 1917, 5: 657-660.]

Two divisions of a sixth grade of 43 pupils each who were of equal initial ability were treated alike in every respect save the dryness of the school room so far as was possible.

The experiment began on December 4, [1916?]. From then until March 30 the "dry" group did their school work for from four to five hours on five days of the week in a room without any humidification whose relative humidity averaged about *28.7* per cent. The "moist" group during the same period worked in a room of approximately *42.2* per cent relative humidity. The two groups were treated alike in respect to curriculum, teaching, and all other physical conditions of the air than moisture. Two teachers divided the work of teaching, one teaching certain subjects to both classes. The temperature was kept alike for both groups, averaging about *67.4°* F. The rooms themselves were alike, the "moist" group beginning in room X which was then humidified by means of an air washer and changing at the middle of the period to room Y which was then humidified. The "dry" group began in room Y, kept as dry as the weather allowed, and changed at the middle of the period to room X, which in turn was then kept dry.

The ventilation of both rooms was controlled in all its details by the staff and plant of the New York State Ventilation Commission, the two schoolrooms having been specially built for experimental work. A full report of the detailed conditions during the experiment will appear later in the report of the commission. For our present purpose it may be accepted that the air conditions for the two groups differed only in dryness, and that the other conditions differed only by chance occurrences, apparently of little or no consequence.

The two groups were tested on December 4 and 5 and again on March 28, 29 and 30, with the following tests, taking in all about 7½ hours of each pupil's time on each occasion. * * * Each pupil was given as a measure of gain in each test the difference between his score in the December test and his score in the same or similar test of March. These gains measure, roughly for each individual and accurately for the group, the increased knowledge and power which has accrued during the time of subjection to the dry and wet conditions.

When the gains in all the tests are combined so as to give approximately equal weight to each, * * * it appears that the "dry" group makes a trifle better showing. Their superiority is, however, no greater than its probable error, and is only one seventh or eighth (according as medians or averages are used) of the mean square deviation of the group in improvement. So far as this experiment goes, then, we find no demonstrable effect of relative humidity on the intellectual progress of school children. What slight difference there is favors the dry condition.

This same substantial lack of difference is found when the gains of the two groups are compared in each test singly. * * * The "dry" group shows more improvement in 9 tests, the "moist" group in 7, with equality in 3 tests. That the two groups were really of equal initial ability is shown by Table III (not reprinted) [which brings out] the superiority of the "dry" group—

By averages	0.79±0.79
By medians	0.7 ±1.0

It may be noted that an extensive series of observations of young women, made by the commission, with still more rigorous equalization of all influences save humidity, showed a result like that reported here for school children.[1] It may be noted also that physical examinations of the children at the beginning and end of the period showed similarly no demonstrable effect of the difference in air conditions, certainly none in favor of the humidified room. It appears unlikely, therefore, that the humidification of schoolrooms during winter will be productive of any improvement in their mental work.

The influence of humidity on comfort, health, and all forms of activity makes all researches such as the above, of general interest. While the brief communication here condensed concludes that humidification of schoolrooms during winter is unlikely to produce improvement in mental work, and this is an interesting result for the psychologist, yet it does not permit the heating engineer to conclude that the actual humidification there employed was without influence on the bodily comfort of the pupils. Perhaps this point will be treated of in the complete re-

[1] The psychological results of this study are reported in *L. I. Stecher:* The effect of humidity on nervousness and on general efficiency, *Archives of Psychology*, No. 38. Dec., 1916.

port, and this is the point usually of most interest to the student of outdoor and indoor climates.

It will be the first move of the climatologist to ascertain where in the United States one usually encounters relative humidities of the amounts experimented with. It appears from charts 17 to 23, inclusive, of MONTHLY WEATHER REVIEW SUPPLEMENT No. 6 (Washington, May, 1917) that the "moist" groups working under a relative humidity of about 42.2 per cent, experienced moisture conditions characteristic of afternoons in January in Utah, Colorado, Arizona, and New Mexico; of July afternoons in a narrow strip running from Williston, N. Dak., through North Platte, Nebr., to Del Rio, Tex.; this is, in fact, the average minimum relative humidity in July for the greater portion of such a strip and is 8 to 10 points lower than the average minimum July relative humidity along the Atlantic seaboard. The "dry" groups were working under an average relative humidity of 28.7 per cent, which is as low as the average minimum value for July throughout northern Iowa, central Wyoming, and central Colorado; and the average October minimum over Colorado from Denver westward, Utah, and Nevada. It is very closely the average afternoon humidity in April over the central portion of the Great Basin, while at the same season the "moist" group would have to be transported to the hills of Kentucky, West Virginia, and eastern Tennessee to find the humidity of their surroundings as low as 42.2 per cent.

In connection with this study it is also very interesting to compare the above results with those secured some years ago by Prof. E. G. Dexter in studying the effects of humidities on the deportment of school children in New York and in Denver.[2] His curve "Deportment—Relative humidity" shows that, under the conditions of nature, and not those artificially produced, there is "an excess of demerits for conditions of low humidity [50–55 per cent] compared with the numbers shown for a moist air [70–85 per cent]. * * * Our inference for this curve must be that excessive restlessness, together with those activities of mind and body which, in the judgment of the teacher constitute disorder, increase with increasing dryness. Yet a dry atmosphere is recognized the world over as a vitalizing one, having the bracing properties which we all recognize in certain characteristics of weather. * * * The teachers find that two tendencies on the part of the pupil are to be combated—inattention and roguishness; * * * the former was more prevalent on stormy and wet days. The present study would tend to prove roguishness more common when the weather is dry and clear. * * *"

At Denver, Colo., "The seeming effects of extremely small humidities, from 10 to 45 per cent, is most startling, giving us an excess of floggings for the Denver school children of 400 per cent [of the normal based on normal Denver conditions]. The low humidity common to Colorado and the higher altitudes makes an excessive stimulus to nervous discharge a permanent one * * *, but when the effect has not been sufficient to bring on other complications, the available energy for rightly directed motor discharge has been increased and some astonishing records are the result." The effect on the mental worker is also recognizable. Work is turned off under higher pressure and generally can not be so long maintained without a resultant partial collapse ensuing; so that the school year there is shortened in recognition of this greater drain on the pupils. It is rather surprising, in view of this widespread experience there, that the New York school tests quoted above show no speeding-up influence. Possibly the schoolroom air, artificially dried as it was, did not carry the same electrical condition that Dexter believes is the fundamental cause of the Colorado records.[3]—C. A., jr.

[2] *Dexter, Edwin Grant.* Weather influences. New York, 1904. Fig. 7, p. 108, and text pp. 123, etc.

[3] See also this REVIEW, March, 1915, 43: 135–6.

SECTION III.—FORECASTS.

FORECASTS AND WARNINGS FOR JUNE, 1917.

By EDWARD H. BOWIE, Supervising Forecaster.

[Dated: Weather Bureau, Washington, D. C., July 23, 1917.]

Of the LOWS that appeared over the United States during the month of June, 8 made their first appearance over the western Canadian Provinces and belong to the Alberta type; 6 first appeared over the far Southwest and are classed as belonging to the Colorado type; and 2 secondary centers of low pressure made their appearance over the Great Central Valleys and are classed as the Central type. It will be noted on examination of Chart III, Tracks of Centers of Low Areas, that many of the storms of this month moved in high latitudes, and especially is this true with regard to the Alberta LOWS, while the Colorado type of LOWS, 6 in number, moved in nearly all instances in a due northeast course toward the Great Lakes and thence passed down the St. Lawrence Valley. The only exception noted and the only LOW not classified is one that formed off the New England coast during the 17th and moved directly northward, crossing the St. Lawrence River and passing into Canada during the 19th. HIGHS were 9 in number, and of these 2 were of the Alberta, 5 of the North Pacific and 2 of the northern Rocky Mountain region type. The most important HIGH of the month is that one which appeared off the North Pacific coast on the 11th and moved slowly east-southeast, and its center passed off the South Atlantic coast on the 18th; this HIGH was attended by unusually high barometer readings for the season, the pressure at its center exceeding 30.60 inches on the 12th to 14th over Wyoming, while unseasonably low temperatures preceded and accompanied it during its march across the United States.

As shown by the daily cabled reports from Honolulu and the Midway Islands the HIGH that normally is centered west of and a considerable distance off the north California coast was of great geographical extent with pressures above the normal, while over the Alaskan area the pressure was also generally above the normal, the important exception being the first decade of the month when nearly all Alaskan stations reported a deficit in pressure. Over the western portion of the North Atlantic Ocean, as shown by the daily reports from the Bermudas, Grand Turks, and the Canadian Maritime Provinces, the pressure was high almost continuously during the month, and especially was this true in the vicinity of the Bermudas, where the excess was pronounced.

WASHINGTON DISTRICT.

Few storm warnings were required during the month, as nearly all the western disturbances were of only moderate intensity while passing over this district. The exceptions were the disturbance that was central the morning of the 2d over southeastern Iowa and which required warnings on the Great Lakes, except western Lake Superior and Ontario, and the storm that was central over northeastern Missouri the evening of the 5th, when storm warnings were displayed on all the Upper Lakes and western Lake Erie. In both instances the warnings were fully verified, particularly with regard to the latter storm, which was not only attended by winds of gale force but also by destructive local storms in the region of the Great Lakes, the Ohio and middle Mississippi Valleys, western Missouri and Kansas. On the 13th southwest storm warnings were ordered for Lake Superior and northern Lakes Michigan and Huron, and the wind conditions occurred as forecast. No storm warnings were issued or required for the east Gulf coast, and the only warnings displayed on the Atlantic coast were in connection with the disturbance that developed off the New England coast on the 17th. warnings being displayed the evening of that day on the coast of Maine.

Warnings of local frosts were issued on a number of days for the northern border States, but no serious damage resulted from the frosts that occurred.

WARNINGS FROM OTHER DISTRICTS.

Chicago district.—While the temperature throughout this forecast district was unseasonably cool most of the month, no frosts actually occurred except in the more elevated regions and in the cranberry marshes of Wisconsin. In the former there is little vegetation susceptible to injury, but in the cranberry marshes there is almost always considerable danger. Special warnings were issued during the month as follows:

Frost warnings were issued for northwestern and central Wyoming on June 5th, 11th, 12th, and 13th; also for southeastern Wyoming on the last date. On June 11th and 12th warnings were issued for the exposed places in Montana, and on the 18th and 30th for extreme northwestern Wyoming. These warnings were generally verified in Wyoming and western Montana, but the frost did not reach to the eastern portion of the latter State.

Advices were sent to the Wisconsin cranberry growers on several dates, but because of the uncertainty regarding the possibility of cloudiness during the ensuing nights the forecasts were in several instances modified to cover the situation.

June 1: Frost warning was sent to Beaver Brook, in the northwestern portion of the State, and frost occurred on the following morning, with a minimum temperature of 28°. The other three stations—Berlin, Cranmoor, and Mather—were advised that the weather would probably remain cloudy but that frost would occur if the weather cleared; however, as cloudiness continued, no frost occurred.

June 3 and 13: Advisory messages were sent to all four stations that the conditions as regards cloudiness and probable frost were doubtful. As it remained cloudy, no frost occurred at any station.

June 14: Frost warnings were sent to the four stations, and heavy frost occurred at Beaver Brook, with a minimum temperature of 26°; but no frost was reported from the other stations, although Cranmoor reported a minimum of 32°.

June 15: Following the warning of frost on the 15th a minimum of 26° was reported at Cranmoor, with a heavy frost, but no frost was reported from the other stations.

June 21; Warnings were issued and minimum temperatures of 32° and 30° were reported from Beaver Brook and Cranmoor, respectively, but no frost was reported at any station.

It may be noted from the above that there was a wide variation in the temperature conditions in the cranberry marsh region within a small area, and this was entirely due to variation in the amount of cloudiness.

The Wisconsin cranberry growers are insistent that warnings be sent them whenever frost is possible, so that they may exercise proper caution, and in order that no frost may possibly occur without being forecast advisory messages are occasionally considered advisable when there seems only slight prospect of occurrence of frost. This is because the cranberry is in bloom during the latter part of June, and is especially susceptible to damage then and for some time previous. Even light frost may prove serious, provided the bogs are not flooded in advance.

Because of the protracted dry weather in May and early in June the Minnesota forests became susceptible to great damage from forest fires, and, following the outbreak of extensive fires, special wind and temperature forecasts were issued to the National and State forests on June 9, 10, 13, 14, 16, 17, and 18, as fresh winds were anticipated. No further advices were deemed necessary during the balance of the month, because of rains in the forest regions eliminating further danger.

In connection with the harvesting of alfalfa it is customary to extend the weather forecast for the alfalfa-growing States in this forecast district to the third day, when fair weather seems probable. Such advices were sent on June 13, 14, and 18 to the States of Iowa, North and South Dakota, Nebraska, Kansas, Montana, and Wyoming; June 23, to Wyoming; June 25, to Minnesota, North and South Dakota, Nebraska, Montana, and Wyoming; June 30, to Nebraska, North and South Dakota, Montana, and Wyoming. All these forecasts were practically fully verified.

In response to a request a special forecast for generally fair weather was made for Rapid City, S. Dak., for the period from June 11 to 16 during the South Dakota Firemen's Tournament, and during the entire period only one light shower occurred. Regarding the advice the observer at Rapid City reports that it was highly satisfactory.—*H. J. Cox, Forecaster.*

New Orleans district.—No general storms occurred on the Gulf coast during June and no storm warnings were issued.

Warnings for alfalfa interests were issued June 6 and repeated on the 7th for Oklahoma and Texas for fair weather up to and including the 9th and for Arkansas up to and including the 8th. Some precipitation occurred in Arkansas and eastern Oklahoma during the night of the 7th, otherwise the weather was fair during the period covered by the forecast.

Warnings for alfalfa interests were issued June 13 for the entire district except Louisiana for fair weather up to and including the 16th and were repeated on the 14th for the entire district. No precipitation occurred during the period covered by the forecast. Warnings were also issued on the 27th for Oklahoma and Texas for fair weather up to and including the 29th. No precipitation occurred in the area specified during the period covered by the forecast.—*I. M. Cline, District Forecaster.*

Denver district.—June was dry, and moderately high pressure prevailed. Such cyclonic areas as affected the district were either in the early stages of development or were of the Alberta type, causing dry southerly winds. The unseasonably cold spring weather of April and May continued during the first seven days of June, but the remainder of the month was generally mild. Warnings of local frost for portions of Colorado and Utah were issued on June 1, 4, 5, 11, 12, and 13, and were generally fully verified. On the morning of the 13th a temperature of 30° was reached at Modena, Utah—the lowest of record at that station for June.

On the evening of the 9th the southward extension of an Alberta LOW was attended by rapidly falling pressure in Utah and northern Arizona, and fire-weather warnings were issued for New Mexico, Arizona, and Utah. High winds occurred on the 10th in Utah and Arizona, reaching 40 miles per hour or more at some stations. On the evening of the 10th the warnings were extended to include northern Colorado, and a velocity of 40 miles occurred in extreme north-central Colorado.

With the exception of high temperatures in portions of Arizona in the latter part of the second decade, the remainder of the month was free from unusual weather conditions. The temperature reached 118° at Yuma on the 15th and 16th, being the highest temperature ever recorded at that station in the month of June.—*Frederick W. Brist, Assistant Forecaster.*

Portland, Oreg., district.—June was nearly a normal month in this forecast district; there were no general rains, although those falling on the 9th and 10th were nearly so. The dominant factor in controlling the month's weather conditions was a high pressure area which was present most of the time off the North Pacific coast.

Frost warnings were issued on the 2d, 4th, and 11th for the eastern portion of the district, and local frost warnings were sent out on the 3d, 9th, and 10th. On the 2d the warning was not verified because general cloudiness prevented the expected rapid radiation; the warnings of the 3d and 10th were fully verified, and the remaining forecasts were partly verified. Frosts occurred on the 2d and 4th in limited areas (two stations reporting on each date), but little damage occurred.

No live-stock warning was issued, but one fire-weather and one storm warning were issued. On the 18th with the prospects of a week of fair warm weather the following warning was sent out:

> Large HIGH over Northwest spreading eastward, LOWS over Arizona and upper Mississippi and Red River Valleys. Light, variable winds to-day, Tuesday, Wednesday; probably mostly easterly Thursday, Friday, Saturday. Continued fair, warm, dry weather. Increasing fire hazard below snow line.

The expected change in wind direction did not occur until Saturday; otherwise it was a good forecast.

On the evening of the 23d a vigorous HIGH reached the northern California coast while a moderate depression was over the mouth of the Columbia River; southeast storm warnings were ordered for that section and Grays Harbor. The warnings were justified, but they should have been extended to Tacoma, where a maximum velocity of 32 miles from the southwest occurred on the afternoon of the 24th. No resulting damage has been reported.

On the morning of the 28th the pressure distribution over the Northwest was expected to result in showers and thunderstorms over the eastern portion of this district, but the LOW moved rapidly northeastward to Alberta and the forecast was not verified at any reporting station.

On account of the greater amount of snow on the ground remaining late into the season, the fire hazard at present is not great, although some small fires have occurred in slashings. The forestry and conservation officials have been keeping in close touch with us, and efforts will be made to afford greater protection from fire than in any previous year.—*T. Francis Drake, Assistant Forecaster.*

San Francisco district.—No storms passed over this district during June, the only rain reported being a shower at Reno, Nev., on the 6th, and a thunderstorm at Winnemucca, Nev., on the 10th. They both occurred without warnings.

The first decade was cool in California, and the first half of the month cool in Nevada. Frosts occurred in northern Nevada on the 11th and 12th, without warnings.

The temperature began to rise in California on the 11th, and continued until the 19th. The rise was in most places gradual and the forecast of continued warm weather after the 12th seemed to cover the situation quite well. On the 15th the extreme maximum temperature, 110° F., occurred at San Luis Obispo; and on the 17th, the record maximum temperature, 106°, occurred at Los Angeles. The intense heat was confined to southern California and the coast in the vicinity of Point Conception.

Fire-weather warnings were issued to the Forest Service on the 18th, and again on the 30th. Damaging fires occurred in San Luis Obispo and Ventura Counties from the 15th to the 19th. While the fires were of incendiary origin, the intense heat, accompanied by strong dry northerly winds, greatly increased their energy.—*G. H. Wilson, District Forecaster.*

SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS DURING JUNE, 1917.

By ALFRED J. HENRY, Professor in Charge.

[Dated: River and Flood Division, July 26, 1917.]

The rainfall of June was very irregularly distributed, as may be seen by inspection of Chart V of this REVIEW. So-called islands of maximum rainfall—a monthly total of 10 inches or more—appear in southwestern Maine, eastern North Carolina, southern Iowa, and southeastern Nebraska. Surrounding these islands of maximum rainfall and extending some distance therefrom, as shown by the chart, are regions of lesser rainfall—8 inches or over.

The character of the rainfall distribution resulted in moderate local floods in various parts of the country. Many of these floods caused little damage, but, on the other hand, many others, as will be shown later, overflowed bottom lands, planted largely to corn, and caused a very considerable loss, measured in the outlay for seed and the labor in preparing and cultivating the ground. In many cases the water quickly ran off the lowlands, and farmers were able to replant these lands to an early maturing variety of corn, hence a total loss of the crop is not probable.

FLOODS IN NEW ENGLAND AND NEW YORK.

Floods in the Mohawk, Oriskany, and Sanquoit Valleys of New York on June 11 caused heavy loss to mills, the destruction of dams, highways, and crops. Farther east, as in the Hudson, the flood was not so severe.

Two flood periods occurred in the rivers of New England, the first on the 12th and the second on the 19th. The last named was specially damaging to lowland crops on the upper reaches of the river. Along the Androscoggin and upper Connecticut the loss to crops is estimated at $300,000.

FLOODS IN THE MIDDLE MISSISSIPPI, LOWER MISSOURI, AND LOWER OHIO VALLEYS.

Very heavy rains on the morning of June 5 caused a sharp rise in the lower Des Moines River, and this in turn caused a rise of 6.5 feet in the Mississippi at Keokuk, Iowa, due to backwater from the Des Moines which empties into the Mississippi a few miles below Keokuk. The initial flood wave in the Mississippi thus produced was augmented by a second period of heavy rains beginning on the 9th. The rains of this period extended eastward to Indiana, and were effective in causing flood stages in the streams of Iowa, Missouri, Illinois, and Indiana. The floods in the smaller streams converged in the Mississippi, with the result that that river was in flood from Keokuk, Iowa, southward to New Madrid, Mo., a distance of nearly 500 miles. Practically all the lowlands in this stretch not protected by levees were overflowed, although the construction of temporary levees in the neighborhood of Cape Girardeau, Mo., was effective in protecting a considerable acreage in that vicinity. The flood-warning service contributed materially to the protective measures that were adopted.

In Indiana both the lower Wabash and the lower White Rivers overflowed into the lowlands and injured the crop prospects in those regions.

The Missouri River from about St. Joseph, Mo., to the mouth of the stream came under the influence of the rains above mentioned, and was in flood generally throughout the stretch mentioned. Fortunately the Kansas River contributed but little flood flow.

FLOOD IN THE COLORADO RIVER.

The cold Spring of 1917 retarded melting of the accumulated snowfall on the elevated portions of the watershed in Colorado, Utah, and Wyoming. Warm weather in June caused a rapid melting of the snow and rapidly rising rivers, especially the Grand, the Gunnison, and the Green. The crest of the Colorado flood passed Yuma, Ariz., on July 1, 1917, at a stage of 29.5 feet. An account of the annual rise in the Columbia will appear in a later issue of the MONTHLY WEATHER REVIEW.

"The Engineering News-Record" of July 5, 1917, contains a brief account of the bursting of the dam which formed the Mammoth reservoir of the Price River Irrigating Co., 6 miles west of Scofield, Utah. The released water formed a maximum flood crest estimated at 20 feet in height, which destroyed approximately 30 miles of railway track, including 10 steel bridges, entailing a loss of of about $2,000,000.

An attempt has been made to ascertain the extent of the overflowed lands along the various streams that were in flood during the month. The results appear in the table below.

Bottom lands overflowed during June, 1917.

River and district.		Overflowed.	Remarks.
Name.	State.		
		Acres.	
Mississippi	Missouri, Arkansas, Tennessee, Mississippi	1,706,840	From backwater on both banks of river, including land between levees.
Colorado	Arizona	400	Opposite Needles, Cal.
White	Indiana	*150,000	
Wabash	do	*150,000	
Susquehanna	New York	250	Reported from Binghamton.
Missouri	Kansas, Missouri	39,470	
Fabius	do	*15,000	
Little Arkansas	Kansas	650	
Des Moines	Iowa	*5,600	
Total		2,068,210	

* Estimated.

Property loss by flood (mostly estimated) in June, 1917.

River.	Tangible property, bridges, etc.	Crops.		Live stock.	Value of warning.
		In hand.	Prospective.		
Mohawk	$2,000	.....	$5,000	(?)	$8,000
Androscoggin	50,000	.....	250,000	.....	.....
Connecticut		.....		.....	.....
Susquehanna	3,500	.....	11,625	.....	.....
Colorado	5,000	$4,000	.....	$1,000	20,000
Lower Mississippi [1] (Vicksburg)	5,000	5,000	30,000	3,000	300,000
Lower White	.....	.....	100,000	.....	.....
Lower Wabash	.....	.....	Heavy.	.....	.....
Middle Mississippi:					
Hannibal, Mo	328,000	.....	211,000	600	15,000
Cairo, Ill	.....	.....	[2] 177,000	.....	100,000
Missouri:					
Kansas City, Mo	63,200	.....	778,250	.....	229,750
Price River, Utah	2,000,000	.....	.....	.....	.....
Total losses	2,456,700	9,000	1,592,875	4,600	672,750

[1] Loss in March, April, and May not previously reported.
[2] Total loss from all circumstances.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

TABLE 1.—*Floods in North Atlantic drainage during June, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Connecticut	White River Junction, Vt.	13	13	15	14.4	13
Do	....do	13	19	20	14.7	19
Hudson	Troy, N. Y.	15	12	13	23.3	12
Do	Albany, N. Y.	12	13	13	12.5	13
Mohawk	Tribeshill, N. Y.	16	.....	.....	15.0	12
Do	Utica, N. Y.	11	11	12	12.0	11
Delaware, East Branch	Fishs Eddy, N. Y.	10	.....	.....	9.9	11
Susquehanna	Oneonta, N. Y.	12	12	12	12.3	12
Chenango	Sherbourne, N. Y.	8	12	13	9.1	12

TABLE 2.—*Floods in South Atlantic drainage during June, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Roanoke	Weldon, N. C.	30	12	12	30.3	12
Neuse	Smithfield, N. C.	13	16	16	13.2	16
Santee	Rimini, S. C.	12	.....	.....	11.5	16
Do	Ferguson, S. C.	12	.....	.....	11.7	16

TABLE 3.—*Floods in Ohio River and tributaries during June, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date
		Feet.			*Feet.*	
Ohio	Evansville, Ind.	35	.....	.....	33.2	4
Do	Mount Vernon, Ind.	35	.....	.....	32.2	5
Do	Shawneetown, Ill.	35	.....	.....	33.7	10
Do	Cairo, Ill.	45	.....	.....	44.6	16, 17
Kiskiminetas	Saltsburg, Pa.	8	7	7	8.5	7
Shenango	Sharon, Pa.	9	.....	.....	8.6	10
Scioto	Circleville, Ohio.	7	30	30	8.3	30
Wabash	Terre Haute, Ind.	16	.....	.....	15.5	11
Do	Vincennes, Ind.	14	7	16	16.0	9
Do	Mount Carmel, Ill.	15	2	19	22.6	12
White	Decker, Ind.	18	1	18	22.8	12
White, East Fork	Shoals, Ind.	20	9	12	23.0	10
White, West Fork	Elliston, Ind.	19	6	15	27.0	8

TABLE 4.—*Floods in the Mississippi River and tributaries during June, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Mississippi	Keokuk, Iowa.	14	5	5	14.7	5
Do	....do.	14	14	19	15.0	17
Do	Warsaw, Ill.	17	5	5	18.2	5, 14
Do	....do.	17	13	18	18.1	15, 17
Do	Quincy, Ill.	14	6	21	17.1	17
Do	Hannibal, Mo.	13	5	23	18.1	9
Do	Louisiana, Mo.	12	6	22	16.2	10
Do	Grafton, Ill.	18	8	24	22.9	14
Do	St. Louis, Mo.	30	11	18	32.9	14
Do	Chester, Ill.	27	12	21	30.7	15, 16
Do	Cape Girardeau, Mo.	30	11	22	34.2	16
Do	New Madrid, Mo.	34	13	22	35.5	17, 18
Do	Memphis, Tenn.	35	.....	.....	34.6	21, 22
Do	Helena, Ark.	42	19	27	43.5	24
Do	Arkansas City, Ark.	42	15	(*)	46.6	27, 28
Do	Vicksburg, Miss.	45	.....	.....	43.7	30
Eastern tributaries.						
Illinois	Morris, Ill.	13		10	13.3	10
Do	Peru, Ill.	14	10	23	16.8	15
Do	Peoria, Ill.	16	7	25	18.3	15
Do	Havana, Ill.	14	12	30	17.1	17
Do	Beardstown, Ill.	12	10	(*)	19.1	17
Do	Pearl, Ill.	12	5 7	(*)	18.2	15–17
Western tributaries.						
Des Moines	Des Moines, Iowa.	17	.....	.....	16.2	10
Do	Ottumwa, Iowa.	10	5	17	16.5	11
Little Arkansas	Sedgewick, Kans.	16	2	2	17.4	2
Neosho	Neosho Rapids, Kans.	22	.....	.....	20.0	5
Petit Jean	Danville, Ark.	20	4	5	21.2	4
White	Georgetown, Ark.	22	.....	.....	20.9	14–16
Black	Black Rock, Ark.	14	9	13	19.7	10
Cache	Jelks, Ark.	9	.....	.....	8.6	21–25

* Continued into July, 1917.

TABLE 5.—*Floods in Missouri River and tributaries during June, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Missouri	Running Water, S. Dak.	16	.....	.....	15.2	28
Do	Blair, Nebr.	15	.....	.....	14.6	30
Do	St. Joseph, Mo.	12	6	13	13.7	10
Do	Kansas City, Mo.	22	3	16	26.7	9
Do	Waverly, Mo.	23	8	13	24.6	10
Do	Boonville, Mo.	21	9	15	23.9	11
Do	Hermann, Mo.	21	9	16	24.8	12
Republican	Clay Center, Kans.	18	.....	.....	17.2	6
Blue	Blue Rapids, Kans.	21	.....	.....	20.8	6
Grand	Brunswick, Mo.	10	(†)	19	19.4	10
Do	....do.	10	29	(*)	11.3	30
Do	Chillicothe, Mo.	18	4	14	31.5	8
Do	....do.	18	29	29	18.0	29

* Continued into July, 1917. † Continued from preceding month.

TABLE 6.—*Floods in West Gulf and Pacific drainage, June, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Rio Grande	San Marcial, N. Mex.	11	(†)	(*)	14.5	16, 20, 21
Colorado	Topock, Ariz.	14	12	(*)	23.3	24
Do	Parker, Ariz.	10	23	24	10.1	23, 24
Grand	State Bridge, Colo.	9	16	28	10.2	20
Do	Grand Junction, Colo.	11	16	26	13.0	18
Do	Fruita, Colo.	16	.....	.....	15.0	20
Roaring Fork	Carbondale, Colo.	6	16	(*)	6.6	18, 19
Eagle	Eagle, Colo.	5	15	28	6.1	18, 19
Gunnison	Sapinero, Colo.	16	10	(*)	19.7	19
Do	Delta, Colo.	9	10	25	9.9	16–18
North Fork of Gunnison	Paonia, Colo.	8	3	30	9.1	13–17
Green	Green River, Wyo.	9	19	(*)	11.4	28, 29
Do	Elgin, Utah.	13	14	(*)	17.5	27
San Joaquin	Firebaugh, Cal.	12	.....	.....	11.5	21–23
Do	Lathrop, Cal.	17	13	13	17.0	13
Kings	Piedra, Cal.	12	8	10	12.6	9, 10
Do	....do.	12	14	20	12.5	18
Columbia	Marcus, Wash.	24	(†)	(*)	30.0	23–25
Do	Wenatchee, Wash.	40	18	29	40.4	20, 21, 24
Do	Umatilla, Oreg.	25	.....	.....	23.7	19
Do	The Dalles, Oreg.	40	20	21	40.4	20
Do	Vancouver, Wash.	15	(†)	(*)	24.5	22
Kootenai	Bonners Ferry, Idaho.	26	19	19	26.0	19
Pend Oreille	Newport, Wash.	16	(†)	(*)	21.6	25–27
Clearwater	Kamiah, Idaho.	14	16	21	15.4	17
Willamette	Portland, Oreg.	15	(†)	(*)	23.8	22

* Continued into July, 1917. † Continued from preceding month.

MEAN LAKE LEVELS DURING JUNE, 1917.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., July 5, 1917.]

The following data are reported in the Notice to Mariners of the above date:

Data.	Lakes.*			
	Superior.	Michigan and Huron.	Erie.	Ontario.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Mean level during June, 1917:				
Above mean sealevel at New York	602.60	581.53	573.53	246.98
Above or below—				
Mean stage of May, 1917	+0.22	+0.39	+0.60	+0.47
Mean stage of June, 1916	−0.83	+0.55	+0.25	+0.88
Average stage for June, last 10 years	+0.34	+0.76	+0.61	−0.06
Highest recorded June stage	−0.83	−2.07	−0.99	−1.65
Lowest recorded June stage	+1.36	+1.63	+1.96	+2.09
Average relation of the June level to—				
May level	+0.4	+0.3	+0.1	+0.2
July level	−0.2	−0.1	+0.1	+0.1

* Lake St. Clair's level: In June, 576.31 feet.

SECTION V.—SEISMOLOGY.

SEISMOLOGICAL REPORTS FOR JUNE, 1917.

W. J. HUMPHREYS, Professor in Charge.

[Dated: Weather Bureau, Washington, D. C., July 1, 1917.]

TABLE 1.—*Noninstrumental earthquake reports, June, 1917.*

Date.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		ALABAMA.								
1917.	*H. m.*		° ′	° ′			*M. s.*			
30	2 23	Greensboro	32 41	87 32	4–5	1	4	Rumbling	This and the next disturbance probably not seismic.	Wm. Gerby.
		Rosemary	32 40	87 30	5	1		Rumbling		H. F. Adams.
30	2 50	Rosemary	32 40	87 30	5	1		Rumbling		H. F. Adams.
		CALIFORNIA.								
2	4 35	Cahuilla	33 32	116 43	4–5	1				Dr. W. L. Shawk.
2	14 30	Victorville	34 32	117 18	3	1				
6	5 ..	Saugus	34 20	118 30	3	1				
7	15 41	Calexico	32 41	115 30	3	1	1			Ivan R. Ralston.
8	0 30	Calexico	32 41	115 30	4	1	3	Rumbling		C. N. Perry.
8	6 13	Calexico	32 41	115 30	3	2	1	Faint		C. N. Perry.
9	3 30	Carmel	36 34	121 56	4	1		Rumbling		Charlotte Vickery.
		Salinas	36 36	121 40	3	1	10	None	Dishes rattled	Dr. E. D. Eddy.
		Soledad	36 28	121 16	5	1	30	None		Wm. Weber.
11	0 20	Calexico	32 41	115 30	3	1	30	Rumbling		H. M. Rouse.
11	2 13	Calexico	32 41	115 30	3	1	½	Rumbling		Ivan R. Ralston.
11	3 54	Julian	33 05	116 37	5	1	5	Rumbling		Wm. L. Schilling.
13	4 06	Calexico	32 41	115 30	3	1	1	Rumbling		Ivan R. Ralston.
17	6 ..	Heber	32 45	115 31	5	1		Rumbling	Shook buildings	
18	9 55	Calexico	32 41	115 30	4	3		Rumbling	Awakened some people	W. J. Best.
18	14 21	Calexico	32 41	115 30	2	1	1	None		C. N. Perry.
22	4 05	Julian	33 05	116 37	4	1	7	Loud		W. J. Norman.
26	13 26	Eureka	40 38	124 11	4	1	3	Rumbling		U. S. Weather Bureau.
27	6 26	Calexico	32 41	115 30	3–4	1	¼	Rumbling	Noise preceded shock	Ivan R. Ralston.
30	23 38	Los Angeles	34 03	118 15	4	1	1	Rumbling	Followed by 4 light shocks	U. S. Weather Bureau.
		IDAHO.								
1	10 35	Cottonwood	46 03	116 20	4	1	12	None		Rev. Father Jerome.
		ILLINOIS.								
9	13 14	Cairo	37 00	89 10	4	1	3	None		U. S. Weather Bureau.
		MISSOURI.								
9	13 14	New Madrid	36 35	89 32	4	1	Few.	Rumbling		Miss Josie Smith.
		NEVADA.								
1	20 37	Winnemucca	40 58	117 43	3	1	2	None		U. S. Weather Bureau.
		TENNESSEE.								
9	13 14	Springville	36 18	88 14	2	1	2	None		H. A. Boden.
		WASHINGTON.								
9	14 30	Glenoma	46 32	122 09	4	1	30	Rumbling	Shook buildings	J. A. Welsh.
		Longmire	46 45	121 50	4–5	1	1	Loud		J. B. Flett.

TABLE 2.—*Instrumental reports, June, 1917.*

[Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.]

[For significance of symbols see REVIEW for January, 1917, p. 26.]

Alaska. *Sitka. Magnetic Observatory.* U. S. Coast and Geodetic Survey. J. W. Green.

Lat. 57° 03′ 00″ N.; long., 135° 30′ 06″ W. Elevation, 15.2 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants		V	T_0
	E	10	16.7
	N	10	15.4

1917.	Character.	Phase.	H. m. s.	Sec.	Amplitude. μ	Amplitude. μ	km.	Remarks.
June 4	.....	P_E	1 32 35	4	.....	.....	.....	Phases uncertain.
		S_E	1 34 42	.....	.....	.....	.....	
		e_N	1 35 26	20	.....	.....	.....	
		L_E	1 36 30	20	.....	.....	.....	
		M_N	1 36 58	18	.....	10	.....	
		M_E	1 37 16	20	10	.....	.....	
		F_E	2 17 ..	.....	.....	.....	.....	
		F_N	2 37 ..	.....	.....	.....	.....	
8	.....	e_N	1 14 40	.....	.....	.....	.....	
		L_E	1 20 31	27	.....	.....	.....	
		L_N	1 20 33	28	.....	.....	.....	
		M_E	1 25 30	18	20	.....	.....	
		M_N	1 31 54	16	.....	100	.....	
		C_E	1 34 ..	16	.....	.....	.....	
		C_N	1 38 ..	13	.....	.....	.....	
		F_E	1 46 ..	.....	.....	.....	.....	
		F_N	2 00 ..	.....	.....	.....	.....	
10	.....	eP_N	4 31 12	.....	.....	.....	.....	Phases uncertain.
		eP_E	4 33 32	.....	.....	.....	.....	
		S_N	4 35 52	.....	.....	.....	.....	
		S_E	4 36 40	.....	.....	.....	.....	
		L_N	4 38 50	20	.....	.....	.....	
		L_E	4 38 55	18	.....	.....	.....	
		M_N	4 40 42	11	.....	100	.....	
		M_E	4 42 40	8	20	.....	.....	
		C_N	4 47 ..	9	.....	.....	.....	
		C_E	4 49 ..	8	.....	.....	.....	
		F_E	5 11 ..	.....	.....	.....	.....	
		F_N	5 42 ..	.....	.....	.....	.....	
13	.....	e_N	7 26 ..	.....	.....	.....	.....	Nothing on E-W; only long waves on N-S.
		M_N	7 40 ..	19	.....	10	.....	
		F_N	8 17 ..	.....	.....	.....	.....	
24	.....	P_N	20 02 04	.....	.....	.....	.....	Motion very slight; phases doubtful.
		S_E	20 11 30	.....	.....	.....	.....	
		S_N	20 11 32	.....	.....	.....	.....	
		C_N	20 54 ..	.....	.....	.....	.....	
26	.....	P_E	6 01 42	6	.....	.....	.....	
		P_N	6 01 44	10	.....	.....	.....	
		S_E	6 11 42	12	.....	.....	.....	
		S_N	6 11 46	12	.....	.....	.....	
		L_E	6 25 02	25	.....	.....	.....	
		L_N	6 25 06	28	.....	.....	.....	
		M_N	6 28 24	17	.....	920	.....	
		M_E	6 33 02	17	2,400	.....	.....	
		C_E	6 49 ..	.....	.....	.....	.....	
		C_N	6 50 ..	19	.....	.....	.....	
		F_E	8 44 ..	.....	.....	.....	.....	
		F_N	9 00 ..	.....	.....	.....	.....	

Arizona. *Tucson. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat. 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants		V	T_0
	E	10	13.9
	N	10	19.1

1917.	Character.	Phase.	H. m. s.	Sec.	Amplitude. μ	Amplitude. μ	km.	Remarks.
June 1	.....	eP_N	16 50 51	3	.....	.....	.....	Motion very slight on E-W.
		eP_E	16 51 20	.....	.....	.....	.....	
		eL_N	16 51 20	.....	.....	.....	.....	
		M_E	16 51 40	.....	40	.....	.....	
		M_N	16 51 46	6	.....	50	.....	
		F_E	16 57 —	.....	.....	.....	.....	
		F_N	17 05 —	.....	.....	.....	.....	
3	.....	P_E	6 49 34	.....	.....	.....	.....	E-W component not in good adjustment.
		P_N	6 49 39	.....	.....	.....	.....	
		L_N	6 50 22	.....	.....	.....	.....	
		M_N	6 50 39	.....	.....	.....	.....	
		M_E	6 51 27	.....	.....	.....	.....	
		F_E	6 51 52	.....	.....	.....	.....	
		F_N	7 02 09	.....	.....	.....	.....	

Arizona. *Tucson. Magnetic Observatory*—Continued.

1917.	Character.	Phase.	H. m. s.	Sec.	Amplitude. μ	Amplitude. μ	km.	Remarks.
June 3	.....	e_N	11 11 15	2	.....	.....	.....	Nothing on E-W.
		M_N	11 11 50	4	.....	20	.....	
		F_N	11 19 —	.....	.....	.....	.....	
8	.....	P_N	0 57 30	4	.....	.....	.....	
		P_E	0 57 32	.....	.....	.....	.....	
		S_N	1 02 21	5	.....	.....	.....	
		S_E	1 02 31	10	.....	.....	.....	
		L_N	1 06 53	24	.....	.....	.....	
		L_E	1 07 00	20	.....	.....	.....	
		M_E	1 08 53	12	890	.....	.....	
		M_N	1 10 58	18	.....	3,680	.....	
		C_E	1 17 —	12	.....	.....	.....	
		C_N	1 19 —	12	.....	.....	.....	
		F_E	3 34 —	10	.....	.....	.....	
		F_N	3 39 —	10	.....	.....	.....	
10	.....	eP_N	4 36 23	5	.....	.....	.....	
		eP_E	4 38 08	.....	.....	.....	.....	
		L_N	4 40 00	14	.....	.....	.....	
		M_N	4 43 07	13	.....	30	.....	
		M_E	4 43 13	.....	20	.....	.....	
		F_E	5 33 —	.....	.....	.....	.....	
		F_N	5 41 —	.....	.....	.....	.....	
13	.....	e_N	7 05 10	.....	.....	.....	.....	No distinct phases.
		e_E	7 05 21	.....	.....	.....	.....	
		M_E	7 42 38	16	20	.....	.....	
		M_N	7 43 46	15	.....	40	.....	
		F_N	8 27 —	.....	.....	.....	.....	
		F_E	8 31 —	.....	.....	.....	.....	
26	.....	P_N	6 01 33	6	.....	.....	.....	
		P_E	6 01 37	10	.....	.....	.....	
		S_E	6 11 26	11	.....	.....	.....	
		S_N	6 11 41	10	.....	.....	.....	
		L_E	6 24 50	25	.....	.....	.....	
		L_N	6 24 56	22	.....	.....	.....	
		M_E	6 26 02	24	3,400	.....	.....	
		M_N	6 32 57	17	.....	5,800	.....	
		C_E	6 45 00	17	.....	.....	.....	
		C_N	6 45 00	16	.....	.....	.....	
		F_E	8 38 —	15	.....	.....	.....	
		F_N	9 00 —	.....	.....	.....	.....	
29	.....	P_N	16 09 58	4	.....	.....	.....	E-W record defective; no regular waves.
		eP_E	16 11 43	.....	.....	.....	.....	
		L_N	16 14 46	10	.....	.....	.....	
		eL_E	16 15 47	.....	.....	.....	.....	
		M_N	16 15 58	7	.....	20	.....	
		M_E	16 16 19	.....	40	.....	.....	
		F_N	16 54 —	.....	.....	.....	.....	
30	.....	e_N	18 00 40	.....	.....	.....	.....	
		C_N	18 28 —	15	.....	.....	.....	

California. *Berkeley. University of California.*

Lat., 37° 52′ 16″ N.; long., 122° 15′ 37″ W. Elevation, 85.4 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Mount Hamilton. Lick Observatory.*

Lat., 37° 20′ 24″ N.; long., 121° 38′ 34″ W. Elevation, 1,281.7 meters.

(*See* Bulletin of the Seismographic Stations, University of California.)

California. *Point Loma. Raja Yoga Academy.* F. J. Dick.

Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters.

Instrument: Two-component, C. D. West seismoscope.

1917.	Character.	Phase.	H. m. s.	Sec.	Amplitude. μ	Amplitude. μ	km.	Remarks.
June 1	.....	.....	.....	.....	*250	*300	.....	Tremors recorded during the 24 hours ending 15h on dates given.
3	.....	.....	.....	.....	*50	*50	.....	
4	.....	.....	.....	.....	*100	*100	.....	
6	.....	.....	.....	.....	*100	*150	.....	
9	.....	.....	.....	.....	*200	*200	.....	
11	.....	.....	.....	.....	*100	*100	.....	
24	.....	.....	.....	.....	*200	*200	.....	

*Amplitude on instrument.

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
California. *Santa Clara. University of Santa Clara.* J. S. Ricard, S. J.								
Lat., 37° 26′ 36″ N.; long., 121° 57′ 63″ W. Elevation, 27.43 meters.								
(*See* record of the Seismographic Station, University of Santa Clara.)								
Colorado. *Denver. Sacred Heart College.* Earthquake Station. A. W. Forstall, S. J.								
Lat., 39° 40′ 36″ N.; long., 104° 56′ 54″ W. Elevation, 1,655 meters.								
Instrument: Wiechert 80 kg., astatic, horizontal pendulum.								
Instrumental constants								
1917. June 8	.....	P_N	*H. m. s.* 1 01 ..	*Sec.*	μ	μ	*km.*	Preliminaries very indistinct.
		eP_E?	1 08 ..					S_E?
		S_N	1 04 ..					
		L_N	1 08 ..					
		L_E	1 10 ..					
		M_N	1 10 ..	18		*1000		
		M_E	1 11 ..	20	*1000			
		C_E	1 13 ..					
		C_N	1 16 ..					
		F_E	1 17 ..					
		F_N	1 24 ..					
12–13	.....	.....	.....	.....	.....	.....	.....	Distinct activity during day. At times broken waves, other times regular sinusoidal waves.
26	.....	P	6 02 ..					Very good record. Remarkably long on N–S.
		S	6 13 ..					
		L	6 28 ..					
		M_E	6 29 ..	33	*2000			
		M_N	6 30 ..	25		*2500		
		C_E	6 38 ..					
		C_N	6 45 ..					
		F_E	6 47 ..					
		F_N	7 36 ..					
*Trace amplitude.								
District of Columbia. *Washington. U. S. Weather Bureau.*								
Lat., 38° 54′ 12″ N.; long., 77° 03′ 03″ W. Elevation, 21 meters.								
Instrument: Marvin (vertical pendulum), undamped. Mechanical registration.								
Instrumental constants.. V 110 T_0 6.4								
1917. June 1	.....	P?	*H. m. s.* 17 05 29	*Sec.*	μ	μ	*km.* 380?	
		S	17 06 11					
		L?	17 06 55					
		F	17 15 00					
3	.....	P?	7 04 34				290?	
		S	7 05 06					
		L?	7 05 46					
		F	7 12 —					
3	.....	P?	19 53 42				3,360?	
		S?	19 58 40					
		L	20 01 40					
		F	20 10 00					
4	.....	P	1 39 08				6,010	
		S	1 46 45					
		L	1 57 57	20				
		L	1 58 35					
		L	2 03 15	16				
		F	2 09 40					

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
District of Columbia. *Washington. U. S. Weather Bureau*—Continued.								
1917. June 7	.....	P_E	*H. m. s.* 3 05 00	*Sec.*	μ	μ	*km.* 7,760	No phases distinguishable on N–S.
		S_E	3 14 08					
		L_E	3 21 00					
		F	3 35 —					
8	II_F	P	0 57 31				2,875	Salvador quake.
		S	1 02 05					
		L	1 05 10					
		L	1 06 30	16				
		F	2 45 —					
8	.....	P	3 04 35				2,920	
		S?	3 09 12					
		L	3 14 50					
		F	3 35 —					
9	.....	eL	18 03 00					
10	I_F	P	4 39 53				4,030	
		S	4 45 42					
		L	4 53 36	16				
		F	6 00 —					
12	.....	P?	2 03 24				2,150	
		S	2 07 00					
		F	2 20 —					
13	.....	P?	7 01 37				4,925?	
		S	7 07 15					
		L	7 11 23	16				
		L	7 38 40	24				
		L	7 43 30	20				
		F	9 20 —					
16	.....	P	15 56 03				3,580?	
		S?	16 01 25					
		L	16 08 55					
		F	16 25 —					
16	.....	P?	22 55 47				2,760?	
		S?	23 01 12					
		L	23 10 25					
		F	23 30 —					
22	.....	P?	5 38 22				6,075?	
		S?	5 46 02					
		L	5 56 00					
		F	6 10 —					
24	.....	P	20 07 45				3,800	
		S	20 13 20					
		L	20 17 00					
		F	21 15 —					
26	II_E	P	6 03 44				9,515	
		S	6 14 20					
		L	6 22 00					
		L	6 38 00	30				
		M_E	6 45 00			91		
		F	10 30 —					
27	.....	e	12 06 12					
		S?	12 14 48					
		F	12 20 —					
27	.....	P	12 33 05				3,420	
		S	12 38 17					
		L	12 42 50	20				
		F	13 15 —					
28	.....	L	14 50 00					Scarcely visible on N–S.
		F	15 05 —					
29	.....	P	16 13 34				3,840	
		S?	16 19 12					
		L	16 28 00					
		F	17 00 —					
30	.....	P	17 57 02				3,400	
		S	18 02 12					
		L	18 06 46					
		F	18 35 —					

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

District of Columbia. *Washington. Georgetown University.*

F. A. Tondorf, S. J.

Lat., 38° 54′ 25″ N.; long., 77° 04′ 24″ W. Elevation, 42.4 meters. Subsoil: Decayed diorite.

Instruments: Wiechert 200 kg. astatic horizontal pendulums, 80 kg. vertical.

Instrumental constants..		*V*	T_0	*e*
	E	165	5.4	0
	N	143	5.2	0
	Z	*80*	*3.0*	*0*

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917. June 1	.....	e_E	*H. m. s.* 17 06 06	*Sec.*	*μ*	*μ*	*km.*	Microseisms present. Phases not discernable. Vertical shows e at 17h 06m 20s.
		e_N	17 06 08	.....	.....	.....	.....	
		F	17 17 00	.....	.....	.....	.....	
4	.....	e_E	1 38 00	.....	.....	.....	.....	
		e_N	1 38 52	.....	.....	.....	.....	
		L	1 59 00	20	.....	.....	.....	
		F	2 45 00	.....	.....	.....	.....	
7	.....	e_E	3 05 01	.....	.....	.....	.....	
		e_N	3 05 16	.....	.....	.....	.....	
		F	3 35 00	.....	.....	.....	.....	
8	.....	P	0 57 29	.....	.....	.....	.....	
		S_E	1 02 21	.....	.....	.....	.....	
		S_N	1 02 24	.....	.....	.....	.....	
		eL_E	1 05 03	.....	.....	.....	.....	
		eL_N	1 05 04	.....	.....	.....	.....	
		M	1 07 04	13	*3700	*1200	.....	
		F	2 31 ..	.....	.....	.....	.....	
			VERTICAL.					
		P	*0 57 28*	.....	.....	.....	.....	
		S	*1 02 17*	.....	.....	.....	.....	
		eL	*1 05 08*	.....	.....	.....	.....	
		F	*2 10 00*	.....	.....	.....	.....	
8	.....	e_N	3 05 40	.....	.....	.....	.....	
		e_E	3 05 41	.....	.....	.....	.....	
		eL_E	3 15 08	.....	.....	.....	.....	
		eL_N	3 15 11	.....	.....	.....	.....	
		L_E	3 17 17	.....	.....	.....	.....	
		F	3 26 00	.....	.....	.....	.....	
10	.....	eP_E	4 39 39	.....	.....	.....	.....	
		eP_N	4 39 43	.....	.....	.....	.....	
		S_E	4 45 43	.....	.....	.....	.....	
		S_N	4 45 44	.....	.....	.....	.....	
		eL_N	4 49 43	.....	.....	.....	.....	
		eL_E	4 49 45	.....	.....	.....	.....	
		M_N	4 56 12	17	.....	*300	.....	
		M_E	4 58 57	17	*1800	.....	.....	
		F	5 33 00	.....	.....	.....	.....	
12	.....	eP_E	2 03 22	.....	.....	.....	.....	F lost in microseisms. Phases difficult to distinguish.
		eP_N	2 03 30	.....	.....	.....	.....	
		eL	2 06 57	.....	.....	.....	.....	
		F	2 15 00	.....	.....	.....	.....	
13	.....	e_N	7 07 10	.....	.....	.....	.....	Long waves from 7h 39m 15s to 8h 4m 0s. No distinct maximum.
		e_E	7 07 13	.....	.....	.....	.....	
		eL_E?	7 11 35	.....	.....	.....	.....	
		L_E	7 39 15	.....	.....	.....	.....	
		L_N	7 39 16	.....	.....	.....	.....	
		F	9 08 00	.....	.....	.....	.....	
16	.....	e_E	15 56 06	.....	.....	.....	.....	Microseisms present.
		e_N	15 56 15	.....	.....	.....	.....	
		L_N	16 10 20	.....	.....	.....	.....	
		L_E	16 10 26	.....	.....	.....	.....	
		F	16 30 00	.....	.....	.....	.....	
16	.....	e	22 56 04	.....	.....	.....	.....	Heavy microseisms present.
		L_N	23 10 04	15	.....	.....	.....	
		L_E	23 10 26	15	.....	.....	.....	
		F	23 40 00	.....	.....	.....	.....	
24	.....	e	20 07 47	.....	.....	.....	.....	Microseisms present.
		S_E?	20 13 40	.....	.....	.....	.....	
		S_N?	20 13 43	.....	.....	.....	.....	
		eL?	20 17 00	15	.....	.....	.....	
		F	21 15 00	.....	.....	.....	.....	

* Trace amplitude.

District of Columbia. *Washington. Georgetown University*—Contd.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917. June 26	.....	eP_N	*H. m. s.* 6 03 48	*Sec.*	*μ*	*μ*	*km.*	Phases difficult. Mainka instrument shows P at 6h 3m 42s; S at 6h 13m 42s; and eL at 6h 31m 42s.
		eP_E	6 03 49	.....	.....	.....	.....	
		S	6 14 48	.....	.....	.....	.....	
		M_N	6 43 58	30	.....	*2400	.....	
		M_E	6 45 04	24	*5400	.....	.....	
		F	8 56 00	.....	.....	.....	.....	
			VERTICAL.					
		eP	*6 03 56*	.....	.....	.....	.....	*S*?
		L	*6 38 42*	*40*	.....	.....	.....	
		M	*6 45 28*	.....	.....	.....	.....	
		F	*9 02 00*	.....	.....	.....	.....	
27	.....	e	12 32 21	.....	.....	.....	.....	Sheets changed at 13h 8m 0s while quake was still going on.
		L_E	12 43 16	30	.....	.....	.....	
		L_N	12 44 55	24	.....	.....	.....	
28	.....	L	14 52 00	.....	.....	.....	.....	Record confused by microseisms and local disturbances.
		F	15 05 00	.....	.....	.....	.....	
29	.....	eP	16 12 46	.....	.....	.....	.....	Microseisms present. S_E?
		S_N	16 19 32	.....	.....	.....	.....	
		eL_E	16 22 48	10	.....	.....	.....	
		eL_N	16 22 54	10	.....	.....	.....	
		L	16 29 00	.....	.....	.....	.....	
		F	17 10 00	.....	.....	.....	.....	
30	.....	P	17 57 01	.....	.....	.....	.....	Microseisms present.
		S_E	18 02 12	.....	.....	.....	.....	
		S_N	18 02 13	.....	.....	.....	.....	
		L	18 09 00	20	.....	.....	.....	
		F	18 50 00	.....	.....	.....	.....	

* Trace amplitude.

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neumann.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Milne seismograph of the Seismological Committee of the British Association.

Instrumental constant..	T_0
	18.6

Date.	Character.	Phase.	Time.	Period. T.	Amplitude.	Distance.	Remarks.
1917. June 1.	.....	eL	*H. m. s.* 9 01 24	*Sec.*	*μ*	*km.*	
		M	9 08 00	19	*100	.....	
		C	9 13 ..	.....	.....	.....	
		F	9 31 00	.....	.....	.....	
3	.....	e	15 16 30	.....	.....	.....	
		M	15 22 00	19	*100	.....	
		F	15 43 00	.....	.....	.....	
3	.....	e	19 44 30	.....	.....	.....	
		M	19 52 18	.....	*100	.....	
		F	19 59 00	.....	.....	.....	
4	.....	P	1 41 36	.....	.....	.....	
		L	1 43 54	20	.....	.....	
		M	1 48 48	.....	*600	.....	
		C	1 53 06	.....	.....	.....	
		F	2 54 00	.....	.....	.....	
7	.....	e	3 02 30	.....	.....	.....	
		M	3 03 24	18	*100	.....	
		F	3 18 00	.....	.....	.....	
8	.....	P	1 10 36	.....	.....	.....	
		S	1 14 36	.....	.....	.....	
		L	1 21 18	21	.....	.....	
		M	1 26 30	.....	*3000	.....	
		C	1 47 00	.....	.....	.....	
		F	2 54 00	.....	.....	.....	
10	.....	P	4 37 48	.....	.....	.....	
		L	4 45 12	19	.....	.....	
		M	4 52 24	.....	*3600	.....	
		C	4 56 06	.....	.....	.....	
		F	6 18 00	.....	.....	.....	

* Trace amplitude.

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Hawaii. *Honolulu. Magnetic Observatory*—Continued.								
1917. June 13	.....	eP.....	*H. m. s.* 6 51 00	*Sec.*	*μ*	*μ*	*km.*	
		S.....	6 59 24					
		L.....	7 09 54					
		M.....	7 13 54	20	*3000			
		C.....	7 20 00					
		F.....	10 40 00					
13	.....	eP.....	17 29 12					
		eL.....	17 34 00	21				
		M.....	17 37 54		*500			
		C.....	17 42 00					
		F.....	17 56 00					
16	.....	e.....	23 03 00					
		M.....	23 07 30	18	*100			
		F.....	23 11 00					
17	.....	e.....	8 40 24					
		M.....	9 00 30		*100			
		F.....	9 12 00					
18	.....	e.....	22 35 30					
		M.....	22 40 00	20	*100			
		F.....	22 47 12					
24	.....	eP.....	19 57 36					
		S.....	20 03 30					
		L.....	20 07 06					
		M.....	20 08 00	20	*3200			
		C.....	20 16 00					
		F.....	21 39 00					
26	.....	eP.....	5 57 00					
		S.....	6 03 30					
		L.....	6 07 36		*17000+	*17000+		Record off paper from 6h 07m 36s to 6h 12m 30s.
		C.....	7 05 00					
		F.....	10 39 00					
26	.....	P.....	14 12 54					
		L.....	14 15 48					
		M.....	14 16 18	20	*400			
		C.....	14 25 00					
		F.....	14 51 00					
27	.....	e.....	5 32 30					
		M.....	5 33 06	18	*100			
		F.....	5 46 00					
27	.....	e.....	13 01 00					
		M.....	13 06 24		*500			
		C.....	13 09 00					
		F.....	13 15 00					

* Trace amplitude.

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.

Instrument: Wiechert.

Instrumental constants.—

	V	T_0	*ε*
E	177	3.4	4:1
N	205	3.4	4:1

1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
June 8	.....	iP_N...	0 57 15	1–2½	.....	.....	.....	E–W component illegible.
		S? or L	1 01 42	5–10	.....	.....	.....	
		M_N....	1 02 05	.....	.....	24	.....	
		L_N?...	1 08 44	15–20	.....	.....	.....	
		M_N....	1 09 20	.....	.....	4	.....	F lost in succeeding tremor.
8	.....	eP_N...	1 38 48	.....	.....	.....	.....	
		S? or L	1 43 36	.....	.....	.....	.....	
		M_N....	1 43 40	.....	.....	1	.....	
		F.....	2 14 ..	.....	.....	.....	.....	
26	.....	eP_E...	6 02 41	.....	.....	.....	.....	
		eP_N...	6 02 45	.....	.....	.....	.....	
		S_N....	6 12 48	.....	.....	.....	.....	
		L_N?...	6 30 21	.....	.....	.....	.....	
		L_E....	6 31 35	.....	.....	.....	.....	
		M_E....	6 36 14	.....	.....	24	.....	
		M_N....	6 36 24	.....	.....	11	.....	
		F.....	9 06 00	.....	.....	.....	.....	
29	.....	eP_E...	16 12 54	.....	.....	.....	.....	
		iS_E....	16 16 41	.....	.....	.....	.....	
		eS_E?..	16 17 43	.....	.....	.....	.....	
		L_E....	16 20 07	.....	.....	.....	.....	
		M_E....	16 20 32	.....	5	.....	.....	
		F.....	16 44 00	.....	.....	.....	.....	

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Maryland. *Cheltenham. Magnetic Observatory.* U. S. Coast and Geodetic Survey. George Hartnell.								
Lat., 38° 44′ 00″ N.; long., 76° 50′ 39″ W. Elevation, 71.6 meters.								
Instruments: Two Bosch-Omori, 10 and 12 kg.								
Instrumental constants.—			*V*	T_0				
		E	10	33				
		N	10	25				
1917. June 1	.....	P_E....	*H. m. s.* 17 06 07	*Sec.* 4	*μ*	*μ*	*km.*	Record very faint; no distinct phases.
		P_N....	17 06 14	3	.....	.....	.....	
		M_E....	17 07 12	5	10	.....	.....	
		M_N....	17 07 42	.....	.....	10	.....	
		F_N....	17 09 ..	.....	.....	.....	.....	
		F_E....	17 13 ..	.....	.....	.....	.....	
4	.....	eP_E...	1 46 11	5	.....	.....	.....	Phases not well-defined.
		eP_N...	1 46 56	5	.....	.....	.....	
		M.....	1 59 44	16	10	10	.....	
		F_E....	2 14 ..	.....	.....	.....	.....	
		F_N....	2 25 ..	.....	.....	.....	.....	
8	.....	P_N....	0 57 29	3	.....	.....	.....	
		P_E....	0 57 35	3	.....	.....	.....	
		S_N....	1 02 25	8	.....	.....	.....	
		S_E....	1 02 27	9	.....	.....	.....	
		L_E....	1 05 11	18	.....	.....	.....	
		L_N....	1 05 12	18	.....	.....	.....	
		M_E....	1 07 12	18	550	.....	.....	
		M_N....	1 07 18	16	.....	310	.....	
		C_N....	1 15 ..	15	.....	.....	.....	
		C_E....	1 16 ..	13	.....	.....	.....	
		F_N....	3 20 ..	.....	.....	.....	.....	
		F_E....	3 30 ..	.....	.....	.....	.....	
10	.....	P_N....	4 39 54	.....	.....	.....	.....	Phases uncertain.
		P_E....	4 39 55	.....	.....	.....	.....	
		S_E....	4 46 00	8	.....	.....	.....	
		S_N....	4 47 04	.....	.....	.....	.....	
		L_E....	4 53 23	13	.....	.....	.....	
		L_N....	4 53 44	14	.....	.....	.....	
		M_N....	4 56 19	10	.....	40	.....	
		M_E....	4 59 07	10	40	.....	.....	
		C_N....	5 00 ..	.....	.....	.....	.....	
		C_E....	5 02 ..	.....	.....	.....	.....	
		F.....	5 31 ..	.....	.....	.....	.....	
13	.....	P_E....	7 07 22	7	.....	.....	.....	Phases uncertain.
		P_N....	7 07 24	4	.....	.....	.....	
		S_N....	7 17 36	.....	.....	.....	.....	
		L_E....	7 39 50	24	.....	.....	.....	
		L_N....	7 40 10	25	.....	.....	.....	
		M_N....	7 48 40	17	.....	40	.....	
		C_N....	7 54 ..	16	.....	.....	.....	
		M_E....	7 54 48	16	20	.....	.....	
		F_N....	8 25 ..	.....	.....	.....	.....	
		F_E....	8 30 ..	.....	.....	.....	.....	
24	.....	P_E....	20 07 54	6	.....	.....	.....	Motion very slight; phases uncertain.
		S_E....	20 13 45	8	.....	.....	.....	
		eS_N...	20 14 36	8	.....	.....	.....	
		L_E....	20 17 07	10	.....	.....	.....	
		M_E....	20 18 30	9	10	.....	.....	
		F.....	20 35 ..	.....	.....	.....	.....	
26	.....	P_N?...	6 03 06	.....	.....	.....	.....	Phases not well defined.
		eP_E...	6 04 00	10	.....	.....	.....	
		S_E....	6 14 26	13	.....	.....	.....	
		S_N....	6 14 29	.....	.....	.....	.....	
		L_E....	6 37 51	34	.....	.....	.....	
		L_N....	6 38 13	26	.....	.....	.....	
		M_E....	6 42 00	28	4,600	.....	.....	
		M_N....	6 44 42	26	.....	3,300	.....	
		C_E....	6 57 ..	17	.....	.....	.....	
		C_N....	7 01 ..	22	.....	.....	.....	
		F_N....	8 51 ..	18	.....	.....	.....	
		F_E....	8 55 ..	18	.....	.....	.....	
27	.....	P_E....	12 32 26	.....	.....	.....	.....	Phases not well defined. Nothing definite on N–S.
		S_E....	12 38 24	10	.....	.....	.....	
		L_E....	12 43 12	20	.....	.....	.....	
		M_E....	12 44 57	20	10	.....	.....	
		F.....	13 02 ..	.....	.....	.....	.....	
29	.....	eP_N...	16 22 06	6	.....	.....	.....	Motion very slight. No distinct phases.
		eP_E...	16 22 49	6	.....	.....	.....	
		M_E....	16 27 43	10	10	.....	.....	
		M_N....	16 30 49	6	.....	10	.....	
		F_N....	16 37 ..	.....	.....	.....	.....	
		F_E....	16 39 ..	.....	.....	.....	.....	
30	.....	e_N....	17 57 03	.....	.....	.....	.....	Phases uncertain.
		e_E....	17 58 21	.....	.....	.....	.....	
		S_N....	18 02 11	8	.....	.....	.....	
		S_E....	18 02 12	8	.....	.....	.....	
		L_N....	18 07 01	.....	.....	.....	.....	
		L_E....	18 07 37	22	.....	.....	.....	
		M_N....	18 09 13	18	.....	10	.....	
		M_E....	18 09 26	18	20	.....	.....	
		C_E....	18 15 ..	15	.....	.....	.....	
		F_N....	18 28 ..	.....	.....	.....	.....	
		F_E....	18 30 ..	.....	.....	.....	.....	

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

Massachusetts. *Cambridge. Harvard University Seismographic Station,* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants.—

	V	T_0	ε
E	80	23	0
N	50	25	4:1

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917. June 1		*O*.....	*H. m. s.* *12 02 04*	*Sec.*	μ	μ	*km.* 2,140	Short period L waves.
		eP_N...	12 06 32					
		eP_E...	12 06 39					
		i_N.....	12 08 32	4				Amplitude of N–S increases.
		S_E....	12 10 07	6				
		eL_E?..	12 11 56	8				
		L_E....	12 12 08	8				Later LL irregular.
		F?.....	12 22 ..					
3		e_E....	7 07 24					
		i.....	7 07 51					
		L_E....	7 09 25					
		L.....	7 11 20	10				
		F.....	7 25 ..					
3		e?.....	19 48 18					
		e.....	19 53 11					
		e.....	19 53 53					
		L_E?...	20 01 18	15				
		F.....	20 20 ..					
4		*O*?....	*1 27 09*				7,240	Distance from L–S.
		eP_E?..	1 38 41					
		S_E.....	1 46 31					
		eL_E...	1 58 54	20				
		L.....	2 02 17					
		F.....	3 19 ..					
5		*O*?....	*4 .. ..*				16,000†	
		eP?...	4 18 25					
		S?.....	4 33 44					
		i.....	4 45 46					
		eL?....	5 01 50	20				
		L_{repl}..	5 27 12 / 5 29 42	15				Distance from L_{repl}—L.
		F.....	5 34 ..					
6		*O*?....	*16 27 19*				6,420?	Distance from eL–S.
		S_E?...	16 45 13	8				Early phases masked by pulsations—not microseisms. Amplitude of E–W increases at L and becomes irregular in period.
		eL_E...	16 55 28	16				
		L.....	17 04 13					
		F?.....	17 40 ..					
7		*O*.....	*2 55 07*				5,600	(N. B. Messines Ridge in France, reported blown up at about 3h.)
		P_E....	3 05 13					
		P_N....	3 05 16					
		S_E....	3 12 28	6				
		eL_E?..	3 20 38	18				
		eL_N...	3 20 50	15				
		L_E....	3 25 34	8				
		F.....	3 42 ..					
7		*O*?....	*20 07 29*				3,625?	Distance from L–S. A weak record.
		eP?...	20 15 24					
		S_E....	20 19 45					
		eL_E...	20 23 20					
		F.....	20 41 ..					
8		*O*.....	*0 51 32*				3,520	San Salvador quake [see dispatches, p. 317.]
		P_E....	0 58 14					
		P_N....	0 58 22					
		S_E....	1 03 32					
		S_N....	1 03 35					
		eL_E...	1 06 20	38				
		eL_N...	1 06 35	16				
		M_E....	1 09 59	17				
		M_E....	1 14 44	15				
		L_{repl}..	3 15 59 / 3 17 59 / 3 26 51	10 / 15 / 13				Amplitude decreases with period.
		F.....	3 38 30					
9		*O*?....	*17 30 12*				7,560?	
		P?.....	17 41 10					
		S_E?...	17 50 13	7				
		eL_E...	18 03 26	16				Period then becomes 17, 20.
		L.....	18 17 26					End of sinusoidals.
		L.....	18 20 12 / 18 23 08	16				
		L.....	18 35 16	16				
		F.....	18 37 20					

† = 20,000 − ½ (25.3 meters × 320 km.).

Massachusetts. *Cambridge. Harvard University Seismographic Station*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917. June 10		*O*.....	*H. m. s.* *4 32 21*	*Sec.*	μ	μ	*km.* 4,500	
		P_E....	4 40 15	3				
		i.....	4 41 45	6–8				
		S_E....	4 46 30					
		L_E....	4 54 12	20				
		M?.....	4 57 43					
		C.....	4 58 45	8				
		C.....	5 08 45					A_E increases again.
		F?.....	5 46 ..					
12		*O*.....	*2 03* ..					Felt in lower St. Lawrence (Klotz).
		e.....	2 03 48					
		i.....	2 04 30					
		i.....	2 04 32	4				
		L_E....	2 04 42	4				
		F.....	2 05 25					
13		*O*?....	*6 49 04*				9,760?	
		eP?...	7 01 54					
		i.....	7 07 38					
		i.....	7 09 02					
		S_E....	7 12 01					Sinusoidal waves set in following S. No definite eL_E. First L probably SS but looks LL.
		L.....	7 18 30	20				
		L.....	7 40 41	20–30				
		M_E....	7 50 37					
		L_{repl}..	9 58 24	20				
		F.....	10 15 10					
16		L_E....	16 11 45	14				e? Periods run down to 8 secs.
		F.....	16 28 41					
16		e?.....	22 59 30					Periods run down to 8 secs.
		L_E?...	23 10 59	15				
		M_E?...	23 13 14	15				
		F.....	23 36 ..					
21		L_E....	14 01 18 / 14 02 18	14				e? Doubtful as to being seismic.
		L_E....	14 04 26 / 14 05 27					
		L_E....	14 06 04 / 14 06 40	8				F?
21		e?.....	2 53 58					Amplitude very small.
		L_E....	2 59 10	20				
		F.....	3 08 06					
22		e.....	5 42 27					
		S?.....	5 46 11	16				
		e.....	5 49 55	12				
		L_E....	5 58 14	20				
		F.....	6 25 52					
24		e?.....	20 07 10					*O* near 20h. Phases indistinct.
		e_E....	20 08 50					
		i_E....	20 13 50	6				
		i.....	20 14 47	9				
		i.....	20 31 26	12				
		L_E....	20 48 28	20				
		F.....	21 50 ..					
26		*O*.....	*5 50 53*				10,000	
		eP_E...	6 03 55					
		i.....	6 08 35					
		i.....	6 14 27					
		S_E....	6 14 43					
		i.....	6 17 46					
		eL_E...	6 33 15	19				
		M_E....	6 40 15 / 7 21 —	50–17				
		F.....	11 08 —					
27		e_N.....	12 34 40	2				E–W component stopped at 12h. N–S, damped, does not register clearly.
28		eL_E	14 42 24	23				
		L.....	14 43 46	18				Amplitude increases.
		F?.....	15 29 —					
29		*O*?....	*16 05 03*				4,780?	Distance from L–S.
		eP_E?..	16 15 48	4				eP_E, 16h 13m 30s, gives 4,480 km. and *O* at 16h 05m 34s.
		S?.....	16 19 48	7				
		eL_E...	16 25 03	9				
		eL_N...	16 25 04					
		L_E....	16 27 47	19–8				
		L_N....	16 27 52					
		F.....	17 22 —					
30		*O*?....	*17 50 34*				3,880	
		iP_N...	17 57 00	2				
		S_N?...	18 02 14	4				S_E masked by local traffic jars.
		eL_E...	18 09 36					
		F.....	18 58 —					

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Missouri. *Saint Louis. St. Louis University.* Geophysical Observatory. J. B. Goesse, S. J.								
Lat., 38° 38′ 15″ N.; long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.								
Instrument: Wiechert 80 kg. astatic, horizontal pendulum.								
Instrumental constants.. V 80, T_0 7, ε 5:1								
1917. June 3	.....	e	*H. m. s.* 15 50 00	*Sec.*	μ	μ	*km.*	
		F	16 02 00					
7	H_T	iP	12 56 06				2,800	
		S	13 00 30					
		L	13 02 00					
		F	13 30 —					
9	.....	eP	15 42 00					
		S?	15 45 30					
		F	16 22 —					
13	.....	eL	7 33 00					
		F	8 14 00					
26	H_Q	eP	18 03 00					
		S?	18 12 30					
		L	18 14 —					
		F	20 38 —					
New York. *Buffalo. Canisius College.* John A. Curtin, S. J.								
Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.								
Instrument: Wiechert, 80 kg., horizontal.								
Instrumental constants.. V 80, T_0 7, ε 5:1								
(Report for June, 1917, not received.)								
New York. *Fordham. Fordham University.* Daniel H. Sullivan, S. J.								
Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.								
Instrument: Wiechert, 80 kg.								
Instrumental constants.. E: V 72, T_0 7.2, ε 1.5:1; N: V 72, T_0 7.2, ε 3.8:1								
(Report for June, 1917, not received.)								
New York. *Ithaca. Cornell University.* Heinrich Ries.								
Lat., 42° 26′ 58″ N.; long., 76° 29′ 09″ W. Elevation, 242.6 meters.								
Instruments: Two Bosch-Omori, 25 kg., horizontal pendulums (mechanical registration).								
Instrumental constants.. E: V 13, T_0 22, ε 4:1; N: V 14, T_0 25, ε 4:1								
(Report for June, 1917, not received.)								
Panama Canal Zone. *Balboa Heights.* Isthmian Canal Commission								
Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters.								
Instruments: Two Bosch-Omori, 100 kg.								
Instrumental constants.. V 10, T_0 20								
1917. June 8	.....	L_N	*H. m. s.* 0 44 19	*Sec.*	μ	μ	*km.* 965	Direction north.
		M_N	0 44 52			*1200		
		M_E	0 45 22		*300			
		F_N	0 46 56					
8	.....	P_N	0 54 08				965	Direction north.
		P_E	0 54 10					
		L_E	0 56 38					
		L_N	0 56 44					
		M_N	0 58 16			*4000		
		M_E	1 01 18		*2000			
		F_E	1 59 00					
		F_N	2 02 05					
8	.....	M_N	3 09 00			*200	965?	Direction north?
13	.....	L_E	7 34 55					Distance and direction unknown.
		M_N	7 39 55			*200		
		M_E	7 41 00		*200			
		F_E	8 07 00					

*Trace amplitude.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. Aa	Amplitude. An	Distance.	Remarks.
Panama Canal Zone. *Balboa Heights*—Continued.								
1917. June 26	.....	P_E	*H. m. s.* 6 03 32	*Sec.*	μ	μ	*km.* 4,830	Direction unknown.
		P_N	6 04 00					
		L_E	6 14 52					
		M_E	6 15 00		*2000			
		L_N	6 15 07					
		M_N	6 16 04			*3000		
		F_E	8 23 00					
		F_N	8 33 20					
27	.....	P_N	12 27 30				465	Direction north.
		P_E	12 27 32					
		L_N	12 28 28					
		L_E	12 28 32					
		M_E	12 28 56		*39000			
		M_N	12 29 04			*68000		
		F_N	12 56 00					
		F_E	12 57 00					
30	.....	P_N	17 51 14				300	Direction probably westerly.
		P_E	17 51 18					
		L_N	17 51 50					
		L_E	17 51 53					
		M_N	17 52 04			*40000		
		M_E	17 52 30		*53000			
		F	18 00 22					
30	.....	P	18 00 22					
		L_N	18 00 57					
		L_E	18 00 58					
		M_N	18 01 05			*19000		
		M_E	18 01 24		*20000			
		F_N	18 16 49					
		F_E	18 17 00					
30	.....	M_E	22 20 03					
		M_N	22 20 04					

*Trace amplitude.

Porto Rico. *Vieques. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. L. Adams.

Lat., 18° 09′ N.; long., 65° 27′ W. Elevation, 19.8 meters.

Instruments: Two Bosch-Omori.

Instrumental constants.. E: V 10, T_0 17.5; N: V 10, T_0 18.0

1917. June 8	.....	e_E	*H. m. s.* 0 56 51	*Sec.* 4	μ	μ	*km.*	Beginning uncertain.
		S	0 59 18					
		L_E	1 01 05	24				
		L_N	1 01 05	28				
		M_E	1 05 00	21	100			
		M_N	1 08 00	17		110		
		C_E	1 11 ..	15				
		C_N	1 14 ..	13				
		F_E	1 57 ..	13				
		F_N	2 05 ..	13				
13	.....	e_E	7 07 15					
		e_N	7 09 44					
		S_E	7 18 36	13				
		S_N	7 18 48					
		L_E	7 38 ..	35				
		L_N	7 39 ..	24				
		M_E	7 40 ..	24	20			
		M_N	7 40 ..	22		10		
		C	8 00 ..	18				
		F_N	9 03 ..					
		F_E	9 08 ..					
26	.....	e_E	6 09 01	6				Beginning uncertain; N–S so thinly smoked that part of record could not be seen.
		e_N	6 09 36	8				
		S_E	6 15 11	12				
		S_N	6 16 54	14				
		L_E	6 40 45	33				
		L_N	6 40 48	32				
		M_E	6 43 00	26	400			
		M_N	6 43 28	28		70		
		C_E	7 04 ..	15				
		F_E	9 04 ..					
30	.....	P_N	17 54 30	4				
		P_E	17 54 33	4				
		S_E	17 57 37	10				
		S_N	17 57 38	7				
		L_N	18 00 13	20				
		L_E	18 00 15	19				
		M_E	18 03 20	18	10			
		M_N	18 06 31	14		10		
		F_E	18 20 ..					
		F_N	18 26 ..					

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

Vermont. *Northfield. U. S. Weather Bureau.* Wm. A. Shaw.

Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters.

Instruments: Two Bosch-Omori, mechanical registration.

	V	T_0
Instrumental constants.. E	10	15
N	10	16

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
June 1	.....	e.....	17 08 00	.....	.....	.....	.....	
		F.....	17 10 ..	.....	.....	.....	.....	
3	.....	e.....	7 06 03	.....	.....	.....	.....	
		F.....	7 15 ..	.....	.....	.....	.....	
4	.....	L.....	1 57 50	.....	.....	.....	.....	
		F.....	2 10 ..	.....	.....	.....	.....	
8	.....	P?.....	0 59 00	.....	.....	.....	3,050?	
		S?.....	1 03 47	.....	.....	.....	.....	
		L.....	1 08 06	.....	.....	.....	.....	
		F.....	2 15 ..	.....	.....	.....	.....	
8	.....	e.....	3 07 00	.....	.....	.....	.....	
		L.....	3 15 30	.....	.....	.....	.....	
		F.....	3 30 ..	.....	.....	.....	.....	
10	.....	P.....	4 40 00	.....	.....	.....	4,400	
		S.....	4 46 10	.....	.....	.....	.....	
		L.....	4 53 35	.....	.....	.....	.....	
		F.....	5 50 ..	.....	.....	.....	.....	
13	.....	e.....	7 02 32	.....	.....	.....	.....	
		L.....	7 12 16	16	.....	.....	.....	
		L.....	7 19 00	20	.....	.....	.....	
		L.....	7 48 00	16	.....	.....	.....	
		F.....	9 00 ..	.....	.....	.....	.....	
24	.....	e.....	20 08 52	.....	.....	.....	.....	
		F.....	20 45 ..	.....	.....	.....	.....	
26	.....	e.....	6 04 15	.....	.....	.....	.....	
		S.....	6 14 35	.....	.....	.....	.....	
		L.....	6 22 00	.....	.....	.....	.....	
		L.....	6 40 00	40	.....	.....	.....	
		F.....	8 40 ..	.....	.....	.....	.....	
29	.....	L.....	16 28 30	.....	.....	.....	.....	
		F.....	16 50 ..	.....	.....	.....	.....	
30	.....	P.....	17 57 33	.....	.....	.....	4,100?	
		S?.....	18 03 26	.....	.....	.....	.....	
		L.....	18 10 45	.....	.....	.....	.....	
		F.....	18 30 ..	.....	.....	.....	.....	

Canada. *Ottawa. Dominion Astronomical Observatory.* Earthquake Station. Otto Klotz.

Lat., 45° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevation, 83 meters.

Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoyer 80 kg. vertical seismograph.

	V	T_0
Instrumental constants..	120	26

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
June 1	.....	eP_N...	17 07 10	.....	.....	.....	.....	
		eP_E?..	17 07 14	.....	.....	.....	.....	
		i_N.....	17 07 35	.....	.....	.....	.....	
		i_E.....	17 07 40	.....	.....	.....	.....	
		i_E.....	17 09 23	.....	.....	.....	.....	
		eL?...	17 09 32	8	.....	.....	.....	
		L_E....	17 10 30	8	.....	.....	.....	
		F.....	17 20 —	.....	.....	.....	.....	
3	.....	eP_N...	7 06 13	.....	.....	.....	.....	
		i_N.....	7 06 35	.....	.....	.....	.....	
		EL_N?.	7 07 48	10	.....	.....	.....	
		i_E.....	7 09 30	.....	.....	.....	.....	
		L_E....	7 09 36	10	.....	.....	.....	
		F.....	7 20 —	.....	.....	.....	.....	
3	.....	eP?...	19 53 36	.....	.....	.....	.....	
		eL.....	20 01 26	8	.....	.....	.....	
		F.....	20 15 —	.....	.....	.....	.....	
4	.....	*O?....	*1 26 45*	.....	.....	.....	7,100?	
		eP?...	1 37 18	.....	.....	.....	.....	
		S_E.....	1 45 52	.....	.....	.....	.....	
		S_N.....	1 46 05	.....	.....	.....	.....	
		L.....	1 57 00	20	.....	.....	.....	
		L.....	2 00 —	18–17	.....	.....	.....	
		L_E....	2 16 —	12	.....	.....	.....	
		F.....	2 30 —	.....	.....	.....	.....	

Canada. *Ottawa. Dominion Astronomical Observatory*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
June 8	.....	*O?....	*0 51 19*	.....	.....	.....	3,730?	Press report San Salvador destroyed. [See p. 317.]
		eP?...	0 58 17	.....	.....	.....	.....	
		iP_N...	0 58 24	.....	.....	.....	.....	
		iS_N...	1 03 43	.....	.....	.....	.....	
		eL.....	1 08 00	28	.....	.....	.....	
		M.....	1 10 00	20–16	30	60	.....	
		L.....	1 15 —	16–18	.....	.....	.....	
		L.....	1 32 —	12	.....	.....	.....	
		LR1?..	3 19 —	13	.....	.....	.....	
		F.....	3 55 —	.....	.....	.....	.....	
9	.....	eN_N...	17 57 18	.....	.....	.....	.....	
		eL_N..	18 03 18	.....	.....	.....	.....	
		L.....	18 05 —	18	.....	.....	.....	
		L.....	18 11 —	18	.....	.....	.....	
		L.....	18 23 —	15	.....	.....	.....	
		F.....	18 40 —	.....	.....	.....	.....	
10	.....	*O.....	*4 32 30*	.....	.....	.....	3,940	
		iP_E...	4 39 44	.....	.....	.....	.....	
		i.....	4 41 10	.....	.....	.....	.....	
		S_E....	4 45 28	.....	.....	.....	.....	
		eL.....	4 50 00	10	.....	.....	.....	
		M.....	4 54 42	20–13	17	80	.....	
		L.....	5 13 —	8	.....	.....	.....	
		L.....	5 30 —	7	.....	.....	.....	
		F.....	6 30 —	.....	.....	.....	.....	
12	.....	e.....	2 03 47	.....	.....	.....	.....	Felt in lower St. Lawrence.
		i.....	2 04 07	.....	.....	.....	.....	
		F.....	2 06 —	.....	.....	.....	.....	
			VERTICAL.					
		*O.....	*2 01 29*	.....	.....	.....	.....	
		*P?....	*2 02 45*	.....	.....	.....	.....	
		*S.....	*2 03 47*	.....	.....	.....	.....	
		*L.....	*2 04 06*	.....	.....	.....	.....	
13	.....	*O.....	*6 48 50*	.....	.....	.....	9,450	
		eP.....	7 01 25	.....	.....	.....	.....	
		eS_N?..	7 11 50	.....	.....	.....	.....	
		iS_E...	7 11 58	.....	.....	.....	.....	
		eL_N..	7 29 24	17	.....	.....	.....	
		L.....	7 35 —	20	.....	.....	.....	
		M.....	7 50 —	17	10	30	.....	Fine sinusoidal waves at M.
		M.....	7 55 —	16	.....	.....	.....	
		M.....	8 05 —	15	.....	.....	.....	
		ME....	8 10 —	15	.....	.....	.....	
		$LR1_N$?	8 48 —	27	.....	.....	.....	
		L.....	9 10 —	20	.....	.....	.....	
		$LR2_N$?	10 06 —	17	.....	.....	.....	
		F.....	10 25 —	.....	.....	.....	.....	
16	.....	e.....	15 55 56	.....	.....	.....	.....	
		e.....	16 03 20	.....	.....	.....	.....	
		eL.....	16 09 42	16–18	.....	.....	.....	
		F.....	16 30 —	.....	.....	.....	.....	
16	.....	e.....	22 57 08	.....	.....	.....	.....	
		eL_N...	23 09 18	11	.....	.....	.....	
		eL_E...	23 10 42	18	.....	.....	.....	
		F.....	23 30 —	.....	.....	.....	.....	
22	.....	*O.....	*5 28 45*	.....	.....	.....	5,650	
		P.....	5 37 54	.....	.....	.....	.....	
		S.....	5 45 11	.....	.....	.....	.....	
		L.....	5 53 18	20	.....	.....	.....	
24	.....	*O?....	*19 54 55*	.....	.....	.....	7,960?	
		P?....	20 06 14	.....	.....	.....	.....	
		S.....	20 15 32	.....	.....	.....	.....	
		eL?...	20 39 48	17	.....	.....	.....	
		L.....	20 50 —	17	.....	.....	.....	
		L.....	21 06 —	16	.....	.....	.....	
		L.....	21 18 —	12	.....	.....	.....	
		F.....	21 50 —	.....	.....	.....	.....	
26	.....	*O.....	*5 50 53*	.....	.....	.....	10.000	
		P_E....	6 03 55	.....	.....	.....	.....	
		S_E....	6 14 53	.....	.....	.....	.....	
		eL_E..	6 32 —	20	.....	.....	.....	
		eL_N..	6 34 —	40	.....	.....	.....	
		M.....	6 47 —	20	70	140	.....	
		L.....	7 00 —	16	.....	.....	.....	
		L.....	7 45 —	15–18	.....	.....	.....	
		LR1..	8 02 —	24	.....	.....	.....	
		L.....	8 08 —	16–19	.....	.....	.....	
		$LR2_N$.	9 53 —	24	.....	.....	.....	
		F.....	10 25 —	.....	.....	.....	.....	
27	.....	eN_N...	12 03 —	.....	.....	.....	.....	Apparently several quakes.
		iN_N...	12 16 32	.....	.....	.....	.....	
		LN_N...	12 26 48	13	.....	.....	.....	
		iN_N...	12 34 00	2	.....	.....	.....	
		iN_N...	12 35 35	2	.....	.....	.....	
27	.....	O.....	*12 35 58*	.....	.....	.....	1,910	
		P.....	12 40 00	.....	.....	.....	.....	
		S.....	12 43 15	.....	.....	.....	.....	
		L_N....	12 45 00	25	.....	.....	.....	
		L_E....	12 46 36	22	.....	.....	.....	
		F.....	14 00 —	.....	.....	.....	.....	

TABLE 2.—*Instrumental reports, June, 1917*—Continued.

Canada. *Ottawa. Dominion Astronomical Observatory*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. Aa	Amplitude. An	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
June 28	.....	eL_N	14 47 —	20	.....	.....	.....	
		L	14 55 —	18	.....	.....	.....	
		F	15 20 —	.....	.....	.....	.....	
29	.....	*O?*	*16 06 53*	.....	.....	.....	4,050?	
		P_E	16 14 15	.....	.....	.....	.....	
		S_N	16 20 05	.....	.....	.....	.....	
		eL_N	16 22 54	8	.....	.....	.....	
		eL_E	16 23 54	8	.....	.....	.....	
		M_N	16 27 54	8	.....	50	.....	
		L	16 30 —	8	.....	.....	.....	
	.....	L	16 35 —	6	.....	.....	.....	
		F	17 05 —	.....	.....	.....	.....	
30	.....	*O*	*17 50 25*	.....	.....	.....	4,150	
		P_N	17 57 54	.....	.....	.....	.....	
		S_E	18 03 50	.....	.....	.....	.....	
		L	18 10 00	24	.....	.....	.....	
		L	18 15 —	18–15	.....	.....	.....	
		L	18 35 —	15	.....	.....	.....	
		F	18 50 —	.....	.....	.....	.....	

Canada. *Toronto. Dominion Meteorological Service.*

Lat., 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.

Instrument: Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation, 1mm., swing of boom=0.50″.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. Aa	Amplitude. An	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
June 3	.....	P?	19 48 48	.....	.....	.....	.....	
		L	19 59 42	.....	.....	.....	.....	
		eL	20 02 12	.....	.....	.....	.....	
		M	20 04 12	.....	*300	.....	.....	
		F	20 17 06	.....	.....	.....	.....	
4	.....	P?	1 36 36	.....	.....	.....	6,790	
		S	1 44 54	.....	.....	.....	.....	
		L	1 57 06	.....	.....	.....	.....	
		iL	2 00 30	.....	.....	.....	.....	
		M	2 01 48	18–24	*1900	.....	.....	
		L	2 33 24	.....	.....	.....	.....	
		F?	3 41 30	.....	.....	.....	.....	
4	.....	L	8 30 06	.....	.....	.....	.....	
		M	8 31 36	.....	*200	.....	.....	
		F	8 35 06	.....	.....	.....	.....	
6	.....	L	5 01 30	.....	.....	.....	.....	
		M	5 08 48	.....	*200	.....	.....	
		F	5 35 00	.....	.....	.....	.....	
6	.....	P?	16 35 30	.....	.....	.....	.....	Doubtful as to being seismic.
		S?	16 43 06	.....	.....	.....	.....	
		L	16 54 12	.....	.....	.....	.....	
		M	16 56 48	.....	*200	.....	.....	
		F	17 09 48	.....	.....	.....	.....	
7	.....	L	3 14 36	.....	.....	.....	.....	
		L	3 17 42	.....	.....	.....	.....	
		M	3 19 00	.....	*400	.....	.....	
		F	3 32 00	.....	.....	.....	.....	
8	.....	S	1 03 00	.....	.....	.....	3,792	San Salvador quake. P not recorded. Distance from L–S.
		L	1 06 00	.....	.....	.....	.....	
		L	1 07 00	.....	.....	.....	.....	
		L	1 07 48	.....	.....	.....	.....	
		iL	1 08 54	.....	.....	.....	.....	
		M	1 09 48	18–24	*8700	.....	.....	
		L_{rep}	3 17 54	.....	.....	.....	.....	
		F	4 04 36	.....	.....	.....	.....	
9	.....	L	18 03 00	.....	.....	.....	.....	Phases interfered with on account of attention to instrument.
		M	18 05 00	.....	700	.....	.....	
10	.....	S	4 45 18	.....	.....	.....	.....	P?
		L	4 52 00	.....	.....	.....	.....	
		iL	4 54 18	.....	.....	.....	.....	
		M	4 54 36	.....	*1800	.....	.....	
		F	5 39 48	.....	.....	.....	.....	
13	.....	P?	7 00 42	.....	.....	.....	9,400?	Distinctly defined. Waves well defined at maxima.
		e	7 06 42	.....	.....	.....	.....	
		S	7 11 12	.....	.....	.....	.....	
		eL	7 42 00	.....	.....	.....	.....	
		M	7 48 18	18–24	*1800	.....	.....	
		M	7 53 12	18–24	*3300	.....	.....	
		M	7 59 12	18	*2300	.....	.....	
		L_{rep}	8 57 12	.....	.....	.....	.....	
		L_{rep}	9 56 12	.....	.....	.....	.....	
		F	10 30 18	.....	.....	.....	.....	

* Trace amplitude.

Canada. *Toronto. Dominion Meteorological Service*—Continued.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. Aa	Amplitude. An	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
June 16	.....	L	16 08 42	.....	*50	.....	.....	
		F	16 23 54	.....	.....	.....	.....	
16	.....	L	16 35 06	.....	*50	.....	.....	
		F	16 52 06	.....	.....	.....	.....	
22	.....	L	5 59 00	.....	.....	.....	.....	
		M	6 00 24	.....	*200	.....	.....	
		F	6 18 54	.....	.....	.....	.....	
24	.....	P?	20 07 18	.....	.....	.....	4,780	S waves well defined.
		iS	20 13 48	.....	.....	.....	.....	
		L	20 16 42	.....	.....	.....	.....	
		M	20 18 12	.....	*300	.....	.....	
		L	20 49 12	.....	.....	.....	.....	
		F	22 17 12	.....	.....	.....	.....	
26	.....	P	6 04 18	.....	.....	.....	9,650	Clear record, well defined and continuous large vibrations. P and S well marked.
		iP	6 07 36	.....	*800	.....	.....	
		S	6 15 00	.....	*5000	.....	.....	
		L	6 32 24	18	.....	.....	.....	
		iL	6 42 00	.....	.....	.....	.....	
		iL	6 49 06	18–24	.....	.....	.....	
		M	6 51 06	18–24	*20000	.....	.....	Amplitude doubtful.
		iL	6 59 00	.....	.....	.....	.....	
		M	7 00 18	.....	*11000	.....	.....	
		iL	7 02 18	.....	.....	.....	.....	
		iL	7 10 30	.....	.....	.....	.....	
		L_{rep}	8 04 18	.....	.....	.....	.....	
		L_{rep}	8 20 36	.....	.....	.....	.....	
		F	10 51 36	.....	.....	.....	.....	
27	.....	e	12 04 18	.....	.....	.....	.....	May be a dual earthquake.
		e	12 26 12	.....	.....	.....	.....	
		P	12 39 24	.....	.....	.....	.....	
		S	12 43 24	.....	.....	.....	.....	
		eL	12 46 24	.....	.....	.....	.....	
		M	12 48 24	.....	*1400	.....	.....	
		M	12 51 06	.....	*1400	.....	.....	
		L_{rep}	13 23 36	.....	.....	.....	.....	
		F	13 47 36	.....	.....	.....	.....	
28	.....	eL	14 48 18	.....	*400	.....	.....	Amplitude doubtful. Some phases lost attending instrument.
		eL	15 06 54	.....	.....	.....	.....	
29	.....	S	16 19 24	.....	.....	.....	.....	P not recorded.
		iL	16 26 00	.....	.....	.....	.....	
		M	16 26 42	.....	*400	.....	.....	
		F?	17 13 00	.....	.....	.....	.....	
30	.....	S?	18 01 36	.....	.....	.....	.....	Beginning of disturbance lost during attention to instrument. Time of S doubtful.
		S	18 02 00	.....	.....	.....	.....	
		eL	18 09 30	.....	.....	.....	.....	
		M	18 11 30	.....	*800	.....	.....	
		F	19 16 24	.....	.....	.....	.....	

*Trace amplitude.

Canada. *Victoria, B. C. Dominion Meteorological Service.*

Lat., 48° 24′ N.; long., 123° 19′ W. Elevation, 67.7 meters. Subsoil: Rock.

Instrument: Wiechert, vertical; Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation, 1 mm., swing of boom=0.54″.

Date.	Phase.	Time.	Period. T.	Amplitude.	Distance.	Remarks.
1917.		*H. m. s.*	*Sec.*	μ	*km.*	
June 3	P	19 41 35	.....	.....	.....	
	L	19 44 04	.....	.....	.....	
	M	19 46 20	.....	*400	.....	
	F	19 50 23	.....	.....	.....	
4	P	1 32 52	.....	.....	1,610	
	S	1 35 39	.....	.....	.....	
	L	1 38 46	.....	.....	.....	
	M	1 42 42	.....	*2000	.....	
	F	2 00 55	.....	.....	.....	
		VERTICAL.		A_z		
	P	*1 32 52*	*3*	.....	.....	*S?*
	L	*1 38 52*	*24*	.....	.....	
	M	*1 39 52*	*24*	*8*	.....	
4	P	8 10 45	.....	.....	.....	
	M	8 12 43	.....	*100	.....	
	F	8 15 40	.....	.....	.....	
6	L	4 44 17	.....	.....	.....	
	M	4 46 11	.....	*200	.....	
	F	5 07 00	.....	.....	.....	

* Trace amplitude.

TABLE 2.—*Instrumental reports, June, 1917*—Concluded.

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. Aa	Amplitude. An	Distance.	Remarks.
Canada. *Victoria, B. C. Dominion Meterological Service*—Continued.								
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
June 7	.....	P or S.	16 22 11	.....	.....	.....	.....	
		L.....	16 37 23	.....	*50	.....	.....	F?
7	.....	P?....	2 55 25	.....	.....	.....	1,100	
		S.....	2 57 24	.....	.....	.....	.....	
		L.....	2 59 52	.....	.....	.....	.....	
		M.....	3 00 52	.....	*200	.....	.....	
		F.....	3 05 50	.....	.....	.....	.....	
8	.....	P?....	1 04 16	.....	.....	.....	4,020	San Salvador quake.
		iP.....	1 06 16	.....	.....	.....	.....	
		S.....	1 10 04	.....	.....	.....	.....	
		L.....	1 14 36	.....	.....	.....	.....	
		M.....	1 19 31	.....	*14000	.....	.....	
		L_{rep}...	3 26 10	.....	.....	.....	.....	
		L_{rep}...	3 29 10	.....	.....	.....	.....	
		F.....	3 53 54	.....	.....	.....	.....	
			VERTICAL.		A_Z			
		P.....	*1 04 16*	*3*	.....	.....	*5,100*	
		S.....	*1 11 04*	*6*	.....	.....	.....	
		L.....	*1 19 06*	*12*	.....	.....	.....	
		M.....	*1 30 28*	*14*	*25*	.....	.....	*F?*
9	.....	P.....	17 41 31	.....	.....	.....	.....	
		L.....	17 44 59	.....	.....	.....	.....	
		M.....	17 47 28	.....	*200	.....	.....	
		F.....	18 04 49	.....	.....	.....	.....	
10	.....	P.....	4 33 34	.....	.....	.....	550	
		L.....	4 34 34	.....	.....	.....	.....	
		M.....	4 35 33	.....	*3000	.....	.....	
		F.....	4 55 23	.....	.....	.....	.....	
			VERTICAL.		A_Z			
		P.....	*4 33 34*	*2*	.....	.....	*550*	
		L.....	*4 34 20*	*6–8*	.....	.....	.....	
		M.....	*4 38 02*	*9*	*33*	.....	.....	
		F.....	*4 48 00*	.....	.....	.....	.....	
10	.....	L.....	6 04 18	.....	.....	.....	.....	Probably part of Italian quake.
		M.....	6 08 16	.....	*200	.....	.....	
		F.....	6 13 44	.....	.....	.....	.....	
13	.....	P.....	7 05 12	.....	.....	.....	6,380	
		S.....	7 13 09	.....	.....	.....	.....	
		L.....	7 20 05	.....	.....	.....	.....	
		M.....	7 31 59	.....	*2000	.....	.....	
		L_{rep}...	9 40 05	.....	.....	.....	.....	
		F.....	10 00 14	.....	.....	.....	.....	
			VERTICAL.		A_Z			
		P.....	*7 05 12*	*3*	.....	.....	.....	*S?*
		L.....	*7 20 30*	*6*	.....	.....	.....	
		M.....	*7 38 42*	*20*	*7*	.....	.....	*F?*
16	.....	P or L.	15 50 30	.....	.....	.....	1,120	
		M.....	15 52 28	.....	*50	.....	.....	
		F.....	15 57 24	.....	.....	.....	.....	
			VERTICAL.		A_Z			
		P or *L*.	*15 50 30*	*6*	.....	.....	*1,120*	
		M.....	*15 52 30*	*7*	*3*	.....	.....	
22	.....	P?....	5 39 43	.....	.....	.....	.....	
		L.....	5 40 42	.....	.....	.....	.....	
		M.....	5 42 11	.....	*200	.....	.....	
		F.....	5 45 40	.....	.....	.....	.....	
24	.....	P.....	20 11 23	.....	.....	.....	.....	L and M lost at cut-off.
		F.....	20 58 59	.....	.....	.....	.....	
26	.....	P.....	6 01 56	.....	.....	.....	7,510	
		S.....	6 10 51	.....	.....	.....	.....	
		L.....	6 25 14	.....	.....	.....	.....	
		M.....	6 30 41	.....	*19000	.....	.....	
		iL.....	7 23 46	.....	.....	.....	.....	
		L.....	8 15 52	.....	.....	.....	.....	
		L.....	8 19 16	.....	.....	.....	.....	
		L_{rep}...	9 35 58	.....	.....	.....	.....	
		L_{rep}...	9 42 16	.....	.....	.....	.....	
		L_{rep}...	9 46 16	.....	.....	.....	.....	
		L.....	9 52 58	.....	.....	.....	.....	
		F.....	10 22 45	.....	.....	.....	.....	
			VERTICAL.		A_Z			
		P.....	*6 02 00*	*6*	.....	.....	*8,200*	
		S.....	*6 11 30*	*12*	.....	.....	.....	
		L.....	*6 25 06*	*18–20*	.....	.....	.....	
		M.....	*6 27 21*	*20*	*83*	.....	.....	*F?*
27	.....	P.....	12 56 26	.....	.....	.....	.....	
		M.....	13 01 24	.....	*200	.....	.....	
		F.....	13 09 50	.....	.....	.....	.....	
28	.....	P.....	14 34 08	.....	.....	.....	.....	
		M.....	14 37 06	.....	*200	.....	.....	
		F.....	14 42 33	.....	.....	.....	.....	
29	.....	P.....	16 23 30	.....	.....	.....	.....	
		M.....	16 26 57	.....	*100	.....	.....	
		F.....	16 33 37	.....	.....	.....	.....	
30	.....	P.....	18 21 46	.....	.....	.....	.....	
		M.....	18 30 41	.....	*100	.....	.....	
		F.....	18 40 37	.....	.....	.....	.....	

* Trace amplitude.

TABLE 3.—*Late seismological reports.* (*Instrumental.*)

Date.	Character.	Phase.	Time.	Period. T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
Massachusetts. *Cambridge. Harvard University Seismographic Station.* J. B. Woodworth.								

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants..	*V*	T_0	*ε*
E	80	23	0
N	50	25	4:1

1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Mar. 29	.....	e_E.....	2 17 53	6	.....	.....	.....	Record overlooked in March. First phases masked by microseisms.
		eL?...	2 20 11	24	.....	.....	.....	
		M?....	2 28 04	20	.....	.....	.....	
		L.....	2 46 59	10	.....	.....	.....	
		F?....	3 00 —	.....	.....	.....	.....	
29	.....	L?....	3 08 00	10	.....	.....	.....	Probably part of preceding quake.
		F?....	3 08 20	.....	.....	.....	.....	
Apr. 21	.....	*O*?....	*0 52 10*	.....	.....	.....	8,450?	Only quake in April. Possibly iF. Interpretation doubtful. A very slight.
		i_N.....	1 12 55	3	.....	.....	.....	
		i_E.....	1 12 55	2	.....	.....	.....	
		S_E.....	1 13 37	10	.....	.....	.....	
		L_E.....	1 29 46	20	.....	.....	.....	
		L.....	1 38 56	18	.....	.....	.....	
		L.....	1 45 56	20	.....	.....	.....	
		F?....	2 04 30	.....	.....	.....	.....	

SEISMOLOGICAL DISPATCHES.[1]

Washington, D. C., June 8, 1917.

Dispatches from American Minister Long at San Salvador sent at 9 o'clock last night while the volcano of San Salvador was erupting said part of the city had been destroyed by fire but that it was under control. Great damage was done.

Washington, D. C., June 8, 1917.

A dispatch said that about 6:35 p. m. yesterday severe earthquake shocks began and continued until about 8:45 with varying degrees of intensity. At about 8:45 the volcano of San Salvador began to belch forth fire and smoke apparently on the side toward Quezaltepeque. There was later one very severe shock, but the tremors of the earth continued with decreasing violence. At the same time there was a steady shower of dry ashes falling over the city. (Assoc. Press.)

Rome, June 11, 1917.

Four violent earthquakes early to-day caused a panic at Terni. Dispatches received here assert considerable damage was done. All inhabitants of the town fled to the open fields and are now camping out there, fearing further earth tremors. Terni is a town of about 31,000 population, located in the Province of Perugia, 49 miles northeast of Rome. A big Government arsenal is there. The town is famed for its Roman ruins and a cathedral. (Assoc. Press.)

San Salvador, Republic of Salvador, June 14, 1917.

Several earthquake shocks of varying intensity were felt here yesterday and to-day, but no damage has been reported.

The various relief committees are distributing provisions to the destitute, and shelters are being built to house the thousands of homeless who at present are encamped on the streets. The wounded are being attended by the Red Cross. Several bodies have been recovered at Armenia and Quezaltepeque. The tracks of the Occidental Railway are covered by streams of lava. Several craters of the volcano have formed into one. (——)

Seward, Alaska, June 18, 1917.

The Pavlof and Shishaldin Volcanoes on the Alaskan Peninsula were in violent action late in May and early in June, according to word brought here to-day by the steamer *Dora*. Smoke and flames poured forth night and day from the Pavlof crater. An earthquake shock lasting two minutes, of such force that people left their homes, was felt at Unga at 10 p. m., May 30. There have been continuous tremors since the National Geographic Society expedition, led by Dr. Robert F. Briggs of the University of Ohio, left Kodiak to visit Katmai last week. Katmai, Redoubt, Lliamna, and St. Augustine Volcanoes also are active, according to report. (Assoc. Press.)

[1] Reported by the organization indicated and collected by the seismological station at Georgetown University, Washington, D. C.

MEMORANDUM ON THE MISSOURI EARTHQUAKE OF APRIL 9, 1917.

By SIDNEY PAIGE.

[Communicated to the U. S. Weather Bureau by the Director of the U. S. Geological Survey, June 30, 1917.]

The origin of the earthquake is almost certainly connected with a well-defined fault zone trending in a general northwest-southeast direction, and located about 12 to 15 miles southwest of Sainte Genevieve. The course of this fault zone changes radically at a point about 3 miles south-southeast of Weingarten. Northwest of this point the zone trends N. 35°–40° W., but east of the point it swings to the east and follows a S. 85° E. direction for at least 10 miles, beyond which it again follows a more southerly course.

An appreciable movement along any portion of this fault zone should produce vibrations most intense along the fault zone (omitting differences in the character of the rocks involved) and growing less at a distance from the fault zone. A map on which are plotted isoseismals should therefore show a roughly elliptical area, the longer axis of which would be approximately parallel to the fault zone and dependent for its length upon the distance over which movement took place. (All fault movements die out at some point.)

The longer axis of the elliptical area outlined on the isoseismal map [published in this REVIEW, April, 1917, p. 188] trends, however, slightly east of north, and not northwesterly, as might be expected considering the trend of the fault zone. This may be due to several causes. An isoseismal map can be used to discover the locus of earth movement or cause of the disturbance only in a most general way unless the geologic structure and material of the general region and of the particular place from which the data are derived be taken into consideration.

Areas of semiconsolidated or wholly loose material, such as flood-plain deposits or very recent geologic formations, are subject to more intense vibration than older consolidated formations and massive igneous rocks. It is therefore not surprising that the generalized isoseismals in the figure referred to do not reveal a relationship to the northwest trending fault zone mentioned above. Isoseismals drawn on complete geologic maps, where abundant records are available, bring out to an astonishing degree the dependence of relative shock upon geologic structure and material. (Note the San Francisco earthquake data.)

In the case under consideration, the flood-plain deposits of the Mississippi in the southern part of the area have served to increase intensity of shock in this direction, and thus masked the relation of disturbance to the fault zone. More abundant and more evenly distributed records on the northwest quarter would probably have corrected the apparent disagreement in this portion of the area. The extension of the No. V intensity eastward to Vienna is probably an expression of the relation of shock to the easterly trending fault zone. Moreover, the fault zone under consideration is a most irregular one, characterized by many short branching and intersecting faults, permitting movement to take place within restricted areas. Thus, intensities might vary along the fault in a most irregular manner, complicating the interpretation of the data for an isoseismal map. Such seems to be the nature of the data on hand.

SECTION VI.—BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Barnes, Howard Turner.
Production of ring ice or hoar frost in pipes. Ottawa. 1916. 2 plates. tables. 25 cm. (Reprinted from the Transactions of the Royal society of Canada, serv. 3, 1916, v. 10, p. [93]-96.)

Buchanan, John Young.
Comptes rendus of observation and reasoning. Cambridge. 1917. xl, 452 p. front. (port.) plates. tables. 22½ cm. [Includes papers of meteorological interest.]

Canada. Meteorological service.
Report . . . for the year ended December 31, 1914 . . . Ottawa. 1917. xvii, 634 p. tables. 29½ cm. At head of title: Department of marine and fisheries.

Chamber of Commerce of the United States of America.
Relations of climate and business. Washington, D. C. 1915. 8 p. charts. 27½ cm. Special bulletin.

Clayton, Henry Helm.
Effect of short period variations of solar radiation on the earth's atmosphere. Washington. 1917. 18 p. 8 charts. figures. tables. 24½ cm. At head of title: Smithsonian miscellaneous collections, v. 68, no. 3. (Publication 2446.)

Cossu, Angelo.
L'isola di Sardegna; saggio monografico di geografia fisica e di antropogeografia . . . 2d ed. Milano, Roma, Napoli. 1916. [2 l.],[7]-222p. illus. tables. 21 cm. [Climate, p. 55-67.]

Davis, George Henry.
Climatic and living conditions at various centers. New Orleans. 1916. cover-title. [4] p. fold. chart. 23 cm.

Denmark. Meteorologiske institut.
Magnetisk aarbog. Annuaire magnétique, 1915. Kjøbenhavn. 1917. 11 p. (incl. title-page) charts. tables. 32 x 24 cm. (Publikationer for det Danske meteorologiske institut ved C. Ryder, direktør. Aarbøger.) In French.

Eredia, Filippo.
Le brine in Italia. Torino. 1917. 7 p. (incl. title-page) table. 18 cm. (Estratto dal Bollettino bimensuale della Società meteor. ital., Anno 1916, n. 3-5.)
Sul clima di Bagdad. Roma. 1917. 11 p. (incl. title-page) tables. chart. 23½ cm.

Gallé, P. H.
Cyclonen in de Arabische Zee. Utrecht. 1916. 20 p. fold. charts. tables. 24½ cm. (Koninklijk Nederlandsch meteorologisch institut. no. 102. Mededeelingen en verhandelingen, 21.)

Havana. Colegio de Belén. Observatorio meteorológico, magnético y seismico.
Año de 1916. Habana. 1917. 15, [77] p. tables. 36½ cm.

Higgins, Harold Leonard, & Marriott, William McKim.
Colorimetric method for the determination of the CO_2 percentage in air. (Reprinted from the Journal of the American chemical society. v. 39, no. 1. Jan. 1917. p. [68]-71.) (Contribution from the Department of pediatrics, the Johns Hopkins Hospital.) 23 cm.

Hobbs, William Herbert.
Rôle of the glacial anticyclone in the air circulation of the globe. figures. maps. diagrams. 24½ cm. (Reprinted from Proceedings of the American philosophical society, v. 54, no. 218, Aug. 1915, p. 185-225.)

Hoffman, Frederick Ludwig.
A plea and a plan for the eradication of malaria throughout the western hemisphere. [Newark, N. J. 1917.] 65 p. (incl. title-page). charts. tables. 23 cm. (An address read in abstract before the Southern medical association. Tenth annual meeting. Atlanta, November 14, 1916.) [Meteorological relations, p. 14-16; 42; 58.]

Hongkong. Observatory.
Report of the director of the Royal observatory, Hongkong, for the year 1916. Hongkong. 1917. cover-title. 14p. tables. 24½cm.

India. Meteorological department.
Rainfall of India. 1915. Calcutta. 1916. 217 p. tables. 34cm.

Johns Hopkins university, Baltimore.
Contributions to plant physiology. illus. 23½cm. (Reprinted from the Johns Hopkins university Circular, March, 1917, p. 133-228.) [Contains: Atmometric units, by B. E. Livingston; Vapor tension deficit as an index of the moisture condition of the air, by B. E. Livingston; Method for approximating sunshine intensity from ocular observations of cloudiness, by F. N. Hildebrandt.]

Loud, Frank Herbert.
The Colorado sky. (Clippings from the Colorado Springs Gazette, Jan. 21-Feb. 25, 1917. Weekly.)

McAdie, Alexander.
Principles of aërography. Chicago. [1917.] xii, 318 p. illus. plate. figures. tables. 21½cm.

Mialaret, Thomas.
Note sur la météorologie de la Nouvelle-Calédonie en 1916. 10 p. tables. 32½cm. (Supplement au Journal officiel du 24 Février 1917.)

Netherlands. Meteorologisch instituut.
Ergebnisse aerologischer Beobachtungen. 4. 1915. Utrecht. 1916. xi, 108 p. tables. 24½cm. (n°. 106.)

O'Connell, Matthew D.
The meteorology of malaria. (Reprinted from the Journal of tropical medicine and hygiene, Nov. 15, 1912; June 2, 1913; Sept. 1, 1913; Dec. 1, 1913; Apr. 1, 1914; Dec. 15, 1916.)

Reed, William Gardner.
Protection from damage by frost. New York. [1916.] illus. 25½cm. (Reprinted from the Geographical review, v. 1, 1916, no. 2.)

Ryd, V. H.
On computation of meteorological observations. Kjøbenhavn. 1917. [4 l],104p. figures. tables. 25cm. At head of title: Publikationer fra det Danske meteorologiske institut, ved C. Ryder, Direktør. Meddelelser, nr. 3.

Shaw, A. Norman.
Improved methods in hygrometry. Ottawa. 1916. plate. tables. 25cm. (Reprinted from the Transactions of the Royal society of Canada. ser. 3, 1916, v.10, p. [85]-92.)

U. S. Mississippi river commission.
Stages of the Mississippi river and of its principal tributaries for 1916 . . . St. Louis, 1917. lxvi, 79 p. tables. 23cm.

Uruguay. Instituto meteorológico nacional.
Datos del Observatorio central, Montevideo.—Rio de la Plata-Puerto de Montevideo. Año 1916. cover-title. [2],56 p. 32cm.

Wallis, Bertie Cotterell.
The monsoon. 4 galley sheets. "Specially written for Indian education."

Woodhouse, Henry.
Textbook of naval aeronautics . . . New York. 1917. [8],288 p. front. illus. tables. diagrams. 31cm.

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

American philosophical society. Proceedings. Philadelphia. v. 56. no. 3. 1917.
Blair, William R. Aërology. p. 189-211.
Wilson, Edwin Bidwell. Theory of an aeroplane encountering gusts. II. p. 212-245.

Astronomical observatory of Harvard college. Annals. Cambridge. v. 83. pt. 1. 1916.

McAdie, Alexander. The winds of Boston and vicinity. II. p. 28-46.

McAdie, Alexander. The desirability of scientific units in aerology. p. 47-52.

Forbes, Waldo E. Ice saints. p. 53-59.

Electrical world. New York. v. 70. July 14, 1917.

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SECTION VII.—WEATHER AND DATA FOR THE MONTH.

THE WEATHER OF JUNE, 1917.

P. C. DAY, Climatologist and Chief of Division.

[Dated: Weather Bureau, Washington, Aug. 1, 1917.]

PRESSURE AND WINDS.

The distribution of the mean atmospheric pressure over the United States and Canada, and the prevailing direction of the winds for June, 1917, are graphically shown on Chart VII (XLV—57), while the means at the several stations, with the departures from the normal, are shown in Tables I and III.

At the beginning of the month relatively low pressure prevailed over the Lakes region and in the Southwest, but elsewhere pressure was near the normal. From the 1st to 8th several low-pressure areas moved from the far Southwest to the Great Lakes and eastward, and relatively high pressure predominated in the Southeast and Northwest. For the next several days the pressure was low throughout the eastern half of the country, but about the 16th a HIGH area of some magnitude overspread the East generally and pressure above the normal obtained for several days. During the second half of the month an occasional area of relatively low pressure moved from the far West eastward across the country, but during much of the time the prevailing pressure over most sections was above the normal.

The month closed with low pressure in the Northeast, and in the central and northern portion of the Great Plains States; while in the Southeastern States and west of the Rocky Mountains, except in the far Southwest, it was decidedly above the average.

For June as a whole the barometric pressure averaged above the normal over the entire country, except at a few stations near or in the upper Mississippi Valley where it was slightly below normal. The departures from the normal were generally small, although somewhat pronounced in the northern Plateau and northern Pacific regions.

The distribution of the HIGHS and LOWS was generally favorable for southerly winds in most sections from the Great Plains States eastward, while along the Pacific coast they were generally from the north. Elsewhere variable winds prevailed.

TEMPERATURE.

The unseasonable and almost continuous cool weather that had been experienced over practically the entire country since the last week in April continued in most districts during the first two decades in June, during which time some of the lowest temperatures ever experienced in that month were recorded. Temperature conditions for this period are considered in detail on pages 285–289 of this issue of the REVIEW.

During the last decade of the month the temperature was generally above the normal in almost all southern and central districts; but in the North and particularly in the region of the Great Lakes, it continued cool.

For the month as a whole the temperature was below the normal throughout the country except locally along the Atlantic coast and over most of the Southern States from the Atlantic to the Pacific, including California and portions of Nevada and central Oregon, where it was somewhat above the average. Over the northern districts from central New York to central Washington and as far south as southern Kentucky and Missouri, the average temperature for the month ranged from 3 to 6 degrees below the normal.

PRECIPITATION.

June opened with general showers over most of the eastern part of the country, and also in the central districts as far west as eastern Utah. During the next several days rather heavy rain fell in much of the corn belt and in the cotton region, except near the Gulf coast and in western and southern Texas where rain was greatly needed. From the 6th to the 12th considerable rain fell practically everywhere east of the central Plains States, except in the southern portions of the Gulf States. Heavy rains occurred over most of New England and westward to eastern Nebraska. There were many reports from the latter section that the ground was too wet to work. From the 12th to the 19th little or no rain fell in many sections of the country; but in much of the Carolinas, Florida, and most districts near the Gulf coast as far west as western Louisiana liberal rains occurred, while moderate amounts fell in most of Iowa, northern Illinois, parts of Ohio, and over practically all the Lakes region and North Atlantic States.

During the remainder of the month the rainfall was irregularly distributed, although in most sections east of the Mississippi River the falls were ample, the amounts being especially large in western Pennsylvania, southwestern New York, eastern North Carolina, southern Ohio, eastern Michigan, and from central Illinois to eastern Nebraska.

The month closed with generally fair weather, except along the Atlantic coast and in the upper Mississippi Valley and far Northwest, where light to moderate rains prevailed.

For the month as a whole the precipitation was heavy in parts of New England, New York, Pennsylvania, the Carolinas, and Florida, and also in central portions of Ohio, Indiana, and Illinois, the greater part of Iowa, eastern Nebraska, southern Michigan, and central Arkansas. Elsewhere in the eastern half of the country moderate falls occurred, except in portions of the eastern Gulf States, where they were light. Throughout the western Gulf States the fall was generally less than 1 inch, and at points in Mississippi and Louisiana the month was one of the driest of record and much damage to crops resulted. From the Great Plains westward the precipitation was likewise light and below the normal, the

month's total being generally less than half an inch except in the more northern localities, and over large areas no rain occurred.

RELATIVE HUMIDITY.

The relative humidity for the month as a whole was above the normal over the northern half of the country from the Mississippi Valley eastward and in Washington and the southern portion of California and Arizona. Elsewhere humidity was generally below the average for June, especially in the Plains States and portions of central California where the deficiency ranged from 10 to 30 per cent.

GENERAL SUMMARY.

The weather for June as a whole was favorable for crop development, except in the South and Southwest, where lack of moisture prevented plant growth, and in the Northwest where the cool weather delayed advancement.

Winter wheat made excellent progress generally and the weather was favorable for harvesting in the southern and central districts. The growth of spring wheat was somewhat backward, but it made good progress during the latter part of the month. The weather was generally unfavorable for corn, cotton, and some truck crops until the latter part of the month, when warmer weather and well-distributed rainfall caused much improvement in the condition of these crops.

Pastures and ranges were generally in good condition, except during the latter part of the month in portions of the Plains States and western Texas, where rain was much needed.

Some injury to fruit resulted from frosts in the Northwest and from wind and hail in portions of the Mississippi Valley. However, at the end of the month the outlook for fruit was good.

SEVERE LOCAL STORMS.[1]

The following notes of severe storms have been extracted from reports by officials of the Weather Bureau:

Arkansas.—A tornado passed 2 miles south of Harrison at 10:30 a. m. June 5. The path was about 75 yards wide and 4 miles long. Property destroyed was worth about $15,000. On June 6 between 7 and 10 p. m. a tornado moved from Wrightsville to Olena, a distance of about 50 miles. Property loss about $73,000. During the night of June 7 a tornado occurred near Uniontown. Two people were killed and property damage about $4,000. A severe hailstorm on June 8 destroyed crops and damaged buildings near De Queen.

Kansas.—Ten tornadoes are known to have occurred in Kansas during June, 1917, causing the death of 18 persons and the destruction of property valued at about $1,220,000. All occurred in the eastern third of the State—four in the late afternoon or evening of the 1st, five late in the afternoon of the 5th, and one in the early night of the 12th.

The first formed 4 miles west of Coffeyville at 5:05 p. m. of the 1st and moved easterly, devastating a large section of that city. Three persons were killed, a dozen injured, and the property loss amounted to about $500,000. Its path was from 600 to 800 feet wide and it ended 5 miles northeast of the city.

At 6 p. m. June 1 a tornado formed about a mile southwest of Pomona, passing over that town and disappearing 9 miles to the northeast, The path was about a quarter of a mile wide. Two persons were injured and property valued at $15,000 destroyed. Baldwin, 17 miles northeast of Pomona, was visited by a severe windstorm at 6:30 p. m. the same day, which was probably the remnant of the Pomona storm. Damage, about $200.

About 7:30 p. m. on June 1 a tornado formed 3½ miles southwest of Morse and moved northeast into Missouri. The path was about 80 rods wide and 25 miles long. Four persons were killed, two injured, and property damaged to amount of about $10,000.

About 5 p. m. June 5 a tornado formed 5 miles southwest of Clinton and traveled 15 miles northeast. Its path was a quarter of a mile wide. One person was killed, six or eight injured, and practically all of the village of Clinton and a great many farmhouses and residences were destroyed; much stock was killed and several fine orchards ruined. Estimated loss, $50,000.

A tornado formed 3 miles northwest of Troy about 5:45 p. m. June 5 and moved southeast for 2 miles, then east for about 2 miles. Damage by wind, about $15,000, and by heavy rain, about $20,000.

At 6 p. m. June 5 a tornado formed 2½ miles northeast of Shaw and moved northeastward. Its path was 300 yards wide and 15 miles long. One person was killed, one injured, and property damaged to amount of $30,000.

At 6 p. m June 5 a tornado formed near Montana, Kans., and moved northeastward. The path was from 100 to 200 feet wide and 10 miles long. Estimated damage, $7,000.

At 6:15 p. m. June 5 a tornado formed half a mile southwest of Pomona and moved northeastward. Its path was about 40 miles long and 1 mile wide. Property loss, about $10,000.

A tornado formed 9 miles southwest of Eskridge late in the afternoon of June 5, moved northeastward, passing half a mile southeast of that place. It then lifted for about 5 miles, when it again descended with increased intensity. The greatest destruction and loss of life due to the storm occurred in the next 8 miles of its path. All buildings near its center were literally torn to pieces and blown away. The storm struck the little town of Elmont, 8 miles northwest of Topeka, and destroyed or damaged every building. Nine persons were killed and property lost to amount of $500,000. This storm was preceded throughout its course by heavy hail. At Eskridge stones are reported to have fallen that were 14 to 15 inches in circumference and weighed 3 and 4 pounds.

On June 12 between 8:30 and 9 p. m. a tornado formed a few miles northeast of Louisville, Kans., and traveled toward the southeast. Its path was about a fourth to a half mile wide and 15 miles long. Seven persons were injured, a number of residences and barns demolished, and orchards and shade trees blown down. Damage estimated at $75,000. At the same time this tornado was raging a windstorm caused considerable damage at St. Marys, 9 miles east, but it could not be established that this storm was a tornado.

A severe hailstorm, accompanied by high wind and excessive rainfall, swept over portions of Jewell, Mitchell, and Cloud Counties during the early morning of June 5, the hailstones in some sections being as large as hens' eggs, The more severe part of the storm covered about 40 square miles, causing total ruin of thousands of acres of growing crops and the destruction of fine orchards. Stock were killed and barns and buildings blown down.

[1] See also the detailed discussion of the tornadoes of May 25 to June 6, inclusive, with Charts XLV–59 to 67, inclusive, by Prof. H. C. Frankenfield, on pp. 291–298 of this issue.

A severe hailstorm occurred at Dodge City and vicinity from 2:15 to 2:30 p. m. June 5. The hail covered the lawn of the Weather Bureau a foot deep. Some of the stones were as large as a hen's egg. Much damage resulted to windows, gardens, and crops. Nearly every residence on streets running north and south had windows broken. Many gardens and crops were completely destroyed. Damage estimated between one and two million dollars.

Michigan.—A tornado swept through Calhoun, Jackson, Washtenaw, and Wayne Counties during the afternoon of June 6. Four persons were killed, 50 injured, and the property loss was estimated at about $1,000,000.

Missouri.—A tornado swept across Boone County on the night of June 5, moving northeastward, causing 18 deaths and property loss between $400,000 and $600,000.

North Dakota.—Three tornadoes occurred in the vicinity of Judson on June 10. The first about 4:30 p. m., and the other two simultaneously about 5 p. m.; damage nominal. Another severe wind storm appeared 2 miles southeast of Bismarck about 6 p. m. the same date; damage slight.

Pennsylvania.—About 7:30 p. m. June 23 a tornado, accompanied by hail, passed over Saegerstown, moving from the southwest. Many trees were uprooted or broken off, a number of barns were unroofed or completely demolished, and a few farmers were hurt by falling timbers. The storm seemed to have touched only in spots as at places trees 2 feet and over in diameter were twisted off or uprooted, while in other portions of the track small trees and light sheds were not injured.

Tennessee.—A heavy windstorm blew down several small buildings at Milan about 11 p. m. June 1. A severe storm passed through the northern part of Shelby County about 10:30 p. m., on June 8, causing considerable destruction over a path from one-half to 1 mile wide and several miles long. Three people were killed and property valued at $100,000 destroyed. A wind and hail storm from one-half to three-quarters of a mile wide crossed Robertson County during the afternoon of the 20th, causing serious damage to crops.

Wisconsin.—A severe storm occurred in the vicinity of Milwaukee during the night of June 22–23. It was accompanied by hail and the rainfall was the heaviest on record at that station, 5.76 inches in 24 hours. Fifteen people were injured and about 400 families driven from their homes in Menomonee Valley; property loss about $500,000.

Georgia.—On June 3 a destructive hailstorm occurred over portions of Houston, Crawford, Twigg, and Bibb Counties. Hail the size of hens' eggs covered the ground to a depth of 3 inches or more in places; peach trees were stripped of their fruit, and corn, cotton, and gardens badly damaged; estimated loss, $200,000.

LATE ICE IN LAKE SUPERIOR.

In the special paper on the cold spring of 1917, appearing on p. 285 of this REVIEW, reference is made to the late breaking up of the ice in Lake Superior and the northern straits. Further reports show that ice was present in the harbor at Marquette as late as June 26, and ice fields were encountered in the lake as late as the end of the month.

Average accumulated departures for June, 1917.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
	°F.	°F.	°F.	In.	In.	In.	0–10		P. ct.	
New England	62.2	−1.4	−12.3	5.60	+2.60	+0.70	6.3	+1.0	83	+4
Middle Atlantic	69.5	−0.7	−4.7	4.21	+0.60	−1.80	5.6	+0.5	74	+1
South Atlantic	78.9	−0.3	+5.4	4.59	+0.30	−4.60	4.8	−0.2	75	−2
Florida Peninsula	80.3	−0.1	+3.0	4.57	−2.30	−7.50	5.8	+0.7	75	−3
East Gulf	78.0	−0.3	+4.1	2.29	−2.30	−2.10	4.0	−1.0	67	−8
West Gulf	79.4	+0.4	+1.9	1.68	−2.00	−7.90	3.1	−0.8	67	−7
Ohio Valley and Tennessee	70.3	−2.8	−9.2	4.41	+0.20	+2.40	5.1	+0.1	71	0
Lower Lakes	63.5	−3.5	−17.1	4.78	+1.20	+1.30	6.0	+1.1	76	+5
Upper Lakes	57.7	−4.8	−21.3	4.19	+0.90	−1.00	6.0	+0.9	77	+4
North Dakota	60.7	−3.0	−15.1	1.93	−1.80	−4.70	4.3	−0.8	60	−9
Upper Mississippi Valley	67.4	−3.5	−15.9	5.43	+1.10	+0.10	5.4	+0.4	72	+2
Missouri Valley	68.8	−2.1	−7.8	3.18	−1.20	−0.90	3.7	−1.3	63	−4
Northern slope	59.1	−3.0	−20.5	1.45	−0.90	+0.10	4.1	−0.7	56	−4
Middle slope	71.7	−0.1	−6.1	1.29	−2.00	−3.70	2.8	−1.2	51	−10
Southern slope	78.0	+0.8	+0.7	0.70	−0.20	−2.90	2.2	−1.6	39	−19
Southern Plateau	75.5	+0.7	−10.9	0.10	−0.30	−0.90	1.2	−0.8	28	−3
Middle Plateau	65.2	−0.5	−32.5	0.10	−0.40	−0.90	1.2	−2.1	33	−5
Northern Plateau	61.3	−3.6	−23.7	0.52	−0.60	−0.60	4.0	−0.5	47	−5
North Pacific	56.5	−1.1	−13.3	2.05	0.00	−4.50	5.4	−0.6	76	0
Middle Pacific	62.9	+0.3	−10.2	0.00	−0.40	−6.20	1.4	−1.7	55	−9
South Pacific	68.5	+2.4	−4.5	0.00	−0.10	−2.30	1.9	−1.3	61	−5

WEATHER CONDITIONS OVER THE NORTH ATLANTIC DURING JUNE, 1916.

The data presented are for June, 1916, and comparison and study of the same should be in connection with those appearing in the REVIEW for that month. Chart IX (XLV–58) shows for June, 1916, the averages of pressure, temperature, and the prevailing direction of the wind at 7 a. m., 75th meridian time (Greenwich mean noon). It was found impracticable to draw any storm tracks on the chart, as the atmospheric depressions during the month were, for the most part, of light intensity and their movements were too uncertain to plot accurately.

PRESSURE.

June is generally a month of comparatively weak atmospheric circulation with slight pressure gradients. For that month in 1916 these conditions were even more marked than usual, though the distribution of the mean monthly pressure did not differ much from the normal. The North Atlantic, or Azores HIGH, with a crest of 30.19 inches, was not far from the position shown on the normal chart, although it was somewhat larger in area but of less intensity. A low-pressure area with a minimum reading of 29.77 inches was central near the southern coast of Norway. The mean monthly pressure west of the 60th meridian was remarkably uniform, no HIGHS or LOWS appearing in that territory. In the northeastern part of the ocean there was considerable variation in the average pressure for the three decades of the month, and while the barometric readings for the second decade were higher than for the first and third, over all the territory between the 60th and 65th parallels, and

the 10th meridian, east longitude, and the 25th west longitude, the difference was more marked in the western part than in the eastern, as the following figures will show. In the 5-degree square between latitides 60°–65°, longitudes 20°–25° west, the mean for the first decade was 29.93 inches; for the second, 30.27 inches; and for the third, 29.88 inches. In the square between latitudes 60°–65°, longitudes 5°–10° east, the means were: First decade, 29.62 inches; second, 29.94 inches; and third, 29.88 inches.

In the northwest quadrant of the Azores HIGH, the pressure for the last decade was considerably higher than during either of the others; in the square between latitudes 40°–45°, longitudes 30°–35°, the average for the first decade was 30.07 inches; for the second, 30.01 inches; and for the third, 30.28 inches. In mid-ocean and along the North American coast there was comparatively little difference in the readings for the three decades, and in southern waters the variation during the month was even less.

GALES.

Under normal conditions June is freer from gales than any other month, as the highest normal percentage for any one 5-degree square is 7, which characterizes a number of squares between the 50th and 60th parallels and the 25th and 40th meridians. During June, 1916, gales were not observed on more than one day in any one square, with the exception of that between latitudes 40°–45°, longitudes 40°–45°, where they were reported on two days, a percentage of 6. On June 1 there were two fairly well developed areas of low pressure over the western division of the ocean. The first LOW was central near Sydney, C. B. I., and the second near latitude 42°, longitude 34°. The barometric readings at their centers were 29.76 inches and 29.82 inches, respectively, with a ridge of high pressure between; the winds were from light to moderate, and fog occurred off the Banks of Newfoundland. On the same day a third LOW of limited area surrounded the Shetland Islands, although its center could not be accurately located on account of lack of observations. On June 2 the conditions over the western division had changed but little, as the two LOWS remained in practically the same position and without change in intensity and extent, while the ridge of high pressure had developed into a closed area, with a crest of 30.20 inches. The third LOW of June 1 had moved about 10 degrees nearly due east, with its center on the west coast of Norway, near the 62d parallel. One vessel in the vicinity of the Shetland Islands reported a westerly gale of 48 miles an hour, while in the southerly quadrants the winds were from moderate to fresh. The LOW last mentioned moved rapidly toward the northeast, and on the 3d the center was apparently somewhere near Bodo, Norway. On the 3d the pressure was considerably above the normal over that part of the ocean between the 30th and 50th parallels, although a LOW of light intensity was central near Colon, Canal Zone. On the 4th a LOW surrounded Quebec, Canada, where the barometer reading was 29.58 inches; while a second area of low pressure covered the west coast of Scotland, extending as far west as the 10th meridian, west longitude. A few vessels some distance from the center of these LOWS reported winds with a maximum velocity of 40 miles an hour, but in mid-ocean the winds were from light to moderate.

The first LOW moved toward the northeast, and on the 5th the center was near Father Point, where the barometer reading was 29.58 inches; no heavy winds were encountered, but fog prevailed in the southeast quadrant. The second LOW remained in the vicinity of the North Sea from the 5th to the 15th, and during that period the center moved back and forth between the 10th meridian, east longitude, and that of Greenwich. On the 7th this LOW was central near the northeast coast of Scotland, and three vessels between that point and the 20th meridian, west longitude, reported northerly gales of from 40 to 50 miles an hour. On the 9th a fairly well developed LOW, with a minimum barometric reading of 29.76 inches, was central near latitude 42°, longitude 42°, moderate to light winds prevailing. This LOW moved in a northeasterly direction, and on the 10th the center was near latitude 48°, longitude 37°. One vessel in the eastern and two in the southwestern quadrants experienced gales of from 40 to 55 miles an hour, while near latitude 38°, longitude 49°, northerly winds of gale force were reported, the barometric readings in the vicinity ranging from 30.09 to 30.20 inches. From the 10th to the 13th the easterly drift of the LOW was slight, as on the latter date the center was near latitude 36°, longitude 28°, light to moderate winds being the rule during that period.

On the 16th a LOW was central a short distance off the coast of Spain, and three vessels in the northern quadrants reported moderate to strong easterly gales. This LOW remained practically stationary during the next 24 hours; between the 17th and 18th it moved slowly toward the coast, as on the latter date the center was near Balboa, Spain. On the 18th a second LOW of limited extent was central near latitude 40°, longitude 38°. On the 19th it was in practically the same position, and westerly gales were encountered by two vessels 5 degrees south of the center. From the 20th to the 22d an area of low pressure covered the Gulf of St. Lawrence, attended by light to moderate winds, while fog occurred on the first date. On the 23d the center of this disturbance was near St. Johns, Newfoundland, the conditions of wind and weather having changed but little. On the 22d and 23d a second LOW, also of slight intensity, covered a large area between the west coast of Scotland and the 20th Meridian. By the 24th it was central near Glasgow and had contracted somewhat in extent, while the winds remained light to moderate. This disturbance then curved toward the north, and on the 25th surrounded a small area off the north coast of Scotland, the general conditions being about the same as on the 24th. The depression then increased in extent and decreased in intensity, and from the 26th to the 30th occupied a large part of the territory between the 15th Meridian, west longitude, and the coast of continental Europe, between the 50th and 65th parallels. On the 28th a shallow trough of low pressure extended along the coast of the United States and Canada, between the 40th and 50th parallels, light winds and considerable fog prevailing. By the 29th this trough had become a well-defined closed area of low pressure with its center about 150 miles southeast of Halifax; it then moved in a northeasterly direction, and on the 30th covered a small portion of the Gulf of St. Lawrence and the western part of Newfoundland, light to moderate winds prevailing.

TEMPERATURE.

The average temperature of the air over the ocean during June, 1916, was considerably above the normal in mid-ocean, north of the 35th parallel, and also in a lesser degree in the waters adjacent to the European coast. In southern waters and the Gulf of Mexico, the temperatures

were near the normal while along the American coast, north of the 30th parallel there were negative departures, the same conditions holding true, at a number of Canadian and United States Weather Bureau stations on the Atlantic and Gulf coasts, as shown in the following table:

	°F.		°F.
St. Johns, N. F.	+1.6	Norfolk, Va.	−2.3
Sydney, C. B. I.	+0.4	Hatteras, N. C.	−0.5
Halifax, N. S.	−0.6	Charleston, S. C.	−0.5
Eastport, Me.	−0.9	Key West, Fla.	−0.2
Portland, Me.	−4.4	Tampa, Fla.	+0.6
Boston, Mass.	−3.2	Mobile, Ala.	+0.5
Nantucket, Mass.	−1.7	New Orleans, La.	+2.0
Block Island, R. I.	−2.1	Galveston, Tex.	+0.1
New York, N. Y.	−4.3	Corpus Christi, Tex.	+1.3

The lowest individual temperature reading recorded by any vessel during the month was 46° F., which occurred on a number of days in the 5-degree square between latitudes 55°–60°, longitudes 40°–45°, and also in the waters adjacent to the coast of Labrador and in the Gulf of St. Lawrence.

FOG.

The greatest amount of fog during the month occurred in the square between latitudes 40°–45°, longitudes 60°–65°, where it was reported on 16 days, a percentage of 53, while the normal is approximately 35. Off the Banks of Newfoundland, where the normal percentage ranges from 60 to 65, fog was observed on only 7 days during the month under discussion, a percentage of 23, while it was also somewhat below the normal over the eastern portion of the steamer lanes.

Winds of 50 miles per hour (22.4 m./sec.), or over, during June, 1917.

Station.	Date.	Wind.		Station.	Date.	Wind.	
		Velocity.	Direction.			Velocity.	Direction.
		Mis./hr.				*Mis./hr.*	
Bismarck, N. Dak.	10	50	sw.	Mount Tamalpais,			
Do.	13	50	nw.	Cal.	25	52	nw.
Buffalo, N. Y.	3	65	sw.	Do.	27	68	nw.
Do.	7	54	w.	Do.	28	66	nw.
Do.	13	68	sw.	Do.	29	58	nw.
Do.	26	58	sw.	New York, N. Y.	8	50	nw.
Do.	29	56	sw.	Norfolk, Va.	1	64	w.
Charlotte, N. C.	21	60	nw.	North Head,			
Cheyenne, Wyo.	7	50	w.	Wash.	23	72	se.
Do.	11	65	w.	Pittsburgh, Pa.	23	64	nw.
Chicago, Ill.	12	50	w.	Point Reyes Light,			
Cleveland, Ohio.	23	58	nw.	Cal.	1	50	nw.
Concordia, Kans.	5	50	n.	Do.	2	51	nw.
Dallas, Tex.	8	62	s.	Do.	3	59	nw.
Dodge City, Kans.	5	52	nw.	Do.	4	60	nw.
Drexel, Nebr.	22	56	nw.	Do.	9	60	nw.
Duluth, Minn.	6	52	ne.	Do.	10	60	nw.
Flagstaff, Ariz.	10	50	w.	Do.	11	66	nw.
Grand Forks, N.				Do.	20	61	nw.
Dak.	16	51	ne.	Do.	21	62	nw.
Helena, Mont.	1	50	sw.	Do.	22	57	nw.
Lexington, Ky.	1	60	sw.	Do.	23	53	nw.
Memphis, Tenn.	1	50	nw.	Do.	25	51	nw.
Do.	8	56	nw.	Portland, Me.	17	(*)	nw.
Mount Tamalpais,				Raleigh, N. C.	8	53	w.
Cal.	2	57	nw.	Richmond, Va.	24	60	nw.
Do.	9	84	nw.	St. Paul, Minn.	13	52	nw.
Do.	16	54	nw.	Sioux City, Iowa.	22	85	w.
Do.	17	50	nw.	Springfield, Mo.	1	60	se.
Do.	18	62	nw.	Topeka, Kans.	5	60	sw.
Do.	19	56	nw.	Wichita, Kans.	4	54	sw.
Do.	20	72	nw.	Do.	5	70	nw.
Do.	21	68	nw.	Williston, N. Dak.	9	50	nw.
Do.	23	79	nw.				

* Wind records at Portland, Me., have been in error for some months; a table of correct readings is being prepared.—EDITOR.

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by section, June, 1917.

Section.	Temperature.								Precipitation.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	77.7	−0.2	Livingston	104	13†	Hamilton	42	16	3.22	−1.22	Opelika	7.03	Livingston	0.15
Arizona	75.8	+1.2	Sentinel	124	16	Long Valley Ran Sta	16	1	0.06	−0.22	Rosemont	0.80	82 stations	0.00
Arkansas	75.2	−1.3	Centerpoint	105	30	Dutton	37	16	4.87	+0.76	Alicia	8.99	Springbank	0.98
California	69.2	+0.2	Mecca	124	16	Madeline	20	12	0.02	−0.29	Fort Bidwell	0.64	214 stations	0.00
Colorado	58.7	−1.3	2 stations	105	30	Fulford	11	2	0.52	−0.93	Limon	2.00	3 stations	0.00
Florida	79.2	−0.8	Fort Meade	102	8†	Garniers (near)	52	16	5.17	−1.77	Lakeland	10.24	Johnstown	1.76
Georgia	77.6	−0.2	3 stations	103	24	Blue Ridge	41	16	3.06	−1.41	Zebulon	7.46	Macon	0.40
Hawaii (May report)														
Idaho	57.0	−2.1	Garden Valley	105	15	2 stations	20	5†	0.67	−0.86	Burke	2.98	Glenns Ferry	0.00
Illinois	68.5	−2.8	Equality	99	26	Joliet	34	16	5.48	+1.68	Macomb	11.58	Edwardsville	1.09
Indiana	68.1	−3.5	Evansville	98	26	Knox	31	16	5.20	+1.45	Greensburg	9.57	Goshen	1.67
Iowa	66.0	−3.1	Clarinda	100	30	2 stations	32	15	6.65	+2.27	Keosauqua	13.82	Mason City	3.04
Kansas	72.8	−0.3	Phillipsburg	112	30	Tribune	30	2	2.20	−2.13	Holton	8.31	Rome	0.18
Kentucky	70.9	−2.0	Earlington	100	26	3 stations	39	16†	4.30	+0.08	Jackson	6.71	Owensboro	2.59
Louisiana	79.5	−0.3	Angola	106	11	Kelly	42	17	1.29	−4.08	Franklin	3.58	Logansport	0.00
Maryland-Delaware	70.3	+0.1	Ferry Landing, Md	97	27	Oakland, Md	32	17	4.12	−0.16	Salisbury, Md	6.36	Cheltenham, Md	1.51
Michigan	59.2	−5.0	3 stations	90	12†	Humboldt	24	2	4.90	+1.78	Battle Creek	7.82	Houghton	2.07
Minnesota	60.7	−3.8	2 stations	99	17†	2 stations	21	1†	3.26	−0.69	Grand Meadow	10.15	Crookston No. 2	0.53
Mississippi	78.1	−0.6	Fruitland Park	105	25	Duck Hill	43	16†	2.79	−1.67	Batesville	7.64	Meridian	0.21
Missouri	71.0	−2.3	Harrisonville	103	30	Ironton	35	16	3.78	−0.59	Maryville	13.54	Crocker	0.09
Montana	56.7	−2.5	Miles City	94	9	Brenner	11	2	1.58	−1.12	Belton	4.40	Victor	0.13
Nebraska	67.0	−2.0	Cambridge	108	29	Imperial	29	2	3.24	−0.62	Auburn	11.80	Benkelman	0.56
Nevada	63.9	−0.2	3 stations	110	4†	2 stations	20	11	0.13	−0.41	Vya	0.62	18 stations	0.00
New England	63.2	−1.3	Woodstock, Vt	92	20	Van Buren, Me	31	7	6.14	+3.01	Cornish, Me	12.26	Block Island, R. I.	2.51
New Jersey	68.9	−0.1	2 stations	95	24†	Charlotteburg	40	5	4.27	+0.35	Long Branch	7.14	South Orange	2.80
New Mexico	67.9	−0.6	3 stations	106	9†	Luna	19	1	0.29	−0.82	Vance (near)	1.74	31 stations	0.00
New York	63.3	−1.6	Wapinger Falls	90	21	Angelica	32	4	5.79	+2.13	Lake George	11.86	Medford	1.97
North Carolina	72.5	−0.6	3 stations	100	24	Banners Elk	30	17	5.98	+0.75	Sloan	15.27	Chimney Rock	1.39
North Dakota	58.5	−5.3	McKinney	103	9	Watford	19	21	2.08	−1.42	Grand Rapids	6.20	Washburn	0.80
Ohio	66.9	−2.2	Xenia	100	26	2 stations	33	17	4.99	+1.25	Prospect	8.34	Frankfort	2.63
Oklahoma	76.8	+0.6	Mutual	115	12	Hooker	35	2	2.04	−1.85	McAlester	5.57	Mangum	0.23
Oregon	59.4	−0.6	Echo No. 3	100	15	Crescent	13	12	0.69	−0.79	Astoria	4.98	10 stations	0.00
Pennsylvania	66.8	−1.0	2 stations	92	13†	2 stations	32	3†	5.38	+1.23	Corry	9.85	Philadelphia "A"	2.25
Porto Rico	78.3	−0.1	Canóvanas	99	17	Maricao	55	9	7.87	+0.08	Lares	21.00	Vieques	2.63
South Carolina	76.9	−0.6	4 stations	102	24†	Mountain Rest	43	17	4.49	−0.52	Floyd Dale	10.10	Anderson	1.33
South Dakota	62.7	−3.2	2 stations	103	29	2 stations	25	1	2.12	−1.03	Centerville	5.94	Chamberlain	0.39
Tennessee	72.4	−2.0	McMinnville	100	26	Tazewell	34	17	4.85	+0.67	Nashville	8.03	Rogersville	1.80
Texas	81.2	+1.2	Midland	116	12	Tulia	32	3	0.80	−2.15	Bonham	5.35	20 stations	0.00
Utah	62.0	−1.3	St. George	107	15†	Park City	11	11	0.15	−0.57	Clarkston	0.65	22 stations	0.00
Virginia	70.8	−0.8	Danville	99	27	Burkes Garden	28	17	4.11	−0.27	Newport News	8.35	Woodstock	0.27
Washington	58.1	−1.9	Starbuck	102	15	Paradise Inn	25	4†	2.05	+0.65	Cedar Lake	12.80	Maryhill	0.00
West Virginia	67.7	−1.1	Moorefield	99	26	Bluefield	31	17	3.81	−0.68	Mannington	6.58	Brandywine	1.38
Wisconsin	60.1	−4.4	Grantsburg	91	17	Ashland	27	4†	5.27	+1.63	Portage	11.24	Grantsburg	2.06
Wyoming	54.9	−2.5	2 stations	97	29	Dome Lake	15	1	0.88	−0.83	Lagrange	4.15	Soda Butte	T.

† Other dates also.

EXPLANATION OF TABLES AND CHARTS.

(See the REVIEW for January, 1917, p. 40.)

TABLE I.—*Climatological data for Weather Bureau stations, June, 1917.*

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles*						*0–10*	*In.*	*In.*
New England.							**62.2**	**−1.4**										**83**	**5.60**	**+2.6**								**6.3**		
Eastport	76	67	85	29.95	30.03	+0.10	51.6	−2.8	73	28	58	39	1	45	28	49	48	91	7.40	+4.2	18	6,240	s.	39	se.	17	6	10	14	6.8		
Greenville	1,070	6	....	28.85	30.01	.....	58.1	.....	82	13	68	37	7	49	36	.....	.....	.....	8.69	.....	20	.....	.....	.....	.....	.....	9	7	14	.....	.....	.....
Portland, Me.	103	82	117	29.90	30.02	+ .07	58.2	−4.4	86	27	65	45	11	52	26	54	52	83	10.86	+7.5	13	.....	ne.	....	nw.	17	8	4	18	6.9	.....	.....
Concord	288	70	79	29.70	30.00	+ .04	63.8	−0.6	88	20	74	45	5	54	35	.....	.....	.....	8.30	+5.0	15	3,496	se.	22	nw.	17	11	7	12	5.5	.....	.....
Burlington	404	11	48	29.54	29.97	+ .01	62.7	−1.1	81	13	70	46	17	55	27	.....	.....	.....	3.69	+0.4	14	7,049	s.	40	s.	1	6	11	13	6.4	.....	.....
Northfield	876	12	60	29.06	30.00	+ .04	60.8	−1.9	84	20	71	45	26	51	34	56	53	78	5.40	+2.2	16	4,742	s.	30	sw.	3	2	15	13	7.0	.....	.....
Boston	125	115	188	29.87	30.01	+ .05	65.8	0.0	87	20	74	50	11	57	28	60	58	79	4.05	+1.0	13	6,140	sw.	30	w.	17	9	9	12	6.1	.....	.....
Nantucket	12	14	90	30.02	30.03	+ .05	60.6	−0.7	77	28	67	44	1	54	21	58	57	92	7.69	+5.3	15	10,147	sw.	37	sw.	30	5	15	10	5.9	.....	.....
Block Island	26	11	46	29.99	30.02	+ .05	61.2	−0.4	76	23	67	49	1	56	18	59	58	94	2.51	−0.4	11	9,885	sw.	34	w.	3	7	6	17	6.8	.....	.....
Narragansett Pier	.....	9	....	.....	.....	.....	61.5	−2.7	78	23	68	46	1	55	21	.....	.....	.....	3.51	.....	13	.....	s.	.....	.....	.....	16	2	12	.....	.....	.....
Providence	160	215	251	29.84	30.01	+ .04	65.8	−2.5	86	20	74	49	1	57	26	60	57	79	4.33	+1.2	15	7,713	se.	44	nw.	17	7	12	11	6.1	.....	.....
Hartford	159	122	140	29.83	30.00	+ .03	67.4	+0.3	86	22	76	51	1	58	27	61	58	76	4.02	+0.9	16	5,166	s.	31	w.	8	10	11	9	5.7	.....	.....
New Haven	106	117	155	29.91	30.02	+ .05	67.0	+0.1	86	27	75	51	1	59	29	60	58	78	3.36	+0.2	19	4,871	se.	28	sw.	3	6	11	13	6.2	.....	.....
Middle Atlantic States.							**69.3**	**−0.7**										**74**	**4.21**	**+0.6**								**5.6**		
Albany	97	102	115	29.88	29.98	+0.01	66.6	−1.3	86	22	75	51	18	58	29	60	57	73	3.00	−0.8	16	4,821	s.	28	s.	26	9	12	9	5.5	.....	.....
Binghamton	871	10	69	29.07	29.99	+ .02	65.2	−1.0	85	19	75	42	17	55	34	.....	.....	.....	6.63	+3.0	19	3,160	nw.	30	ne.	26	4	12	14	6.5	.....	.....
New York	314	414	454	29.68	30.01	+ .03	68.3	−0.2	87	22	76	53	1	60	22	61	57	74	5.57	+2.3	11	10,246	s.	50	nw.	8	4	14	12	6.5	.....	.....
Harrisburg	374	94	104	29.62	30.01	+ .02	69.8	−0.5	87	22	79	51	16	61	28	62	58	69	3.17	−0.4	15	3,863	nw.	27	w.	3	4	16	10	6.0	.....	.....
Philadelphia	117	123	190	29.90	30.02	+ .04	72.2	+1.0	90	27	81	54	17	63	24	64	60	70	2.25	−1.0	9	6,638	sw.	31	w.	3	10	9	11	5.9	.....	.....
Reading	325	81	98	29.67	30.01	.....	70.4	.....	88	22	80	50	16	61	28	63	59	69	3.26	−0.4	14	4,332	s.	27	n.	14	5	11	14	6.6	.....	.....
Scranton	805	111	119	29.16	30.01	+ .03	66.8	−0.4	86	19	77	46	18	57	31	60	57	73	4.48	+0.9	18	3,907	sw.	38	sw.	8	5	11	14	6.6	.....	.....
Atlantic City	52	37	48	29.98	30.03	+ .05	66.4	−0.4	92	24	72	54	17	60	28	62	60	84	4.29	+1.3	11	5,292	s.	24	s.	14	9	11	10	5.6	.....	.....
Cape May	18	13	49	30.04	30.06	+ .08	66.2	−1.5	92	24	73	55	5	59	30	62	.....	.....	4.03	+1.0	13	5,070	s.	28	w.	14	12	12	6	4.6	.....	.....
Sandy Hook	22	10	57	29.98	30.00	.....	67.2	.....	83	24	74	53	1	60	22	63	61	86	4.03	.....	11	8,742	s.	40	s.	7	8	13	9	5.5	.....	.....
Trenton	190	159	183	29.80	30.00	.....	70.5	.....	88	22	80	52	17	61	27	63	60	74	3.15	−0.3	10	7,143	s.	39	w.	8	6	10	14	6.4	.....	.....
Baltimore	123	100	113	29.89	30.02	+ .03	73.0	0.0	94	27	82	53	16	64	26	64	60	67	4.05	+0.2	13	.....	sw.	....	nw.	6	8	18	4	5.1	.....	.....
Washington	112	62	85	29.90	30.01	+ .01	72.6	−0.1	95	27	83	50	16	62	32	65	61	72	6.25	+2.1	14	3,781	s.	46	nw.	27	10	15	5	4.9	.....	.....
Lynchburg	681	153	188	29.31	30.04	+ .03	72.8	−0.7	95	27	84	49	18	61	35	64	60	71	5.17	+1.3	12	4,458	w.	37	nw.	28	11	16	3	4.8	.....	.....
Norfolk	91	170	205	29.96	30.06	+ .06	74.2	−0.2	95	24	84	57	17	65	27	67	64	77	4.65	+0.3	14	8,425	s.	64	w.	1	5	23	2	5.0	.....	.....
Richmond	144	11	52	29.90	30.04	+ .03	73.6	−1.5	94	27	84	52	17	63	27	66	63	77	5.31	+1.8	15	4,943	s.	60	nw.	24	5	14	11	5.8	.....	.....
Wytheville	2,293	49	55	27.73	30.06	+ .05	65.9	−2.8	90	26	78	38	17	54	35	60	57	77	2.17	−1.9	11	3,445	w.	31	sw.	2	12	13	5	4.1	.....	.....
South Atlantic States.							**75.9**	**−0.3**										**75**	**4.59**	**−0.3**								**4.8**		
Asheville	2,255	70	84	27.77	30.08	+0.07	67.5	−1.2	90	27	79	40	17	56	36	60	56	74	4.43	+0.1	10	3,777	nw.	44	n.	27	9	16	5	5.0	.....	.....
Charlotte	773	153	161	29.24	30.06	+ .05	75.2	−0.3	94	25	86	53	17	65	26	66	61	68	4.70	+0.2	10	6,445	sw.	60	nw.	21	9	14	7	5.3	.....	.....
Hatteras	11	12	50	30.07	30.08	+ .07	73.9	−0.5	85	23	79	60	18	68	16	70	69	85	8.02	+3.7	13	9,177	sw.	40	nw.	14	12	12	6	4.8	.....	.....
Manteo	12	5	43	.....	.....	.....	72.7	.....	91	28	82	50	18	64	...	.....	.....	.....	3.92	−0.4	9	.....	sw.	.....	.....	.....	20	5	5	.....	.....	.....
Raleigh	376	103	110	29.66	30.05	+ .04	75.0	−0.1	93	24	85	54	17	65	26	67	63	72	5.92	+1.2	12	4,649	sw.	53	w.	8	11	14	5	4.4	.....	.....
Wilmington	78	81	91	30.00	30.08	+ .07	75.1	−0.4	90	24	83	58	17	67	23	70	68	83	6.97	+1.4	17	5,424	sw.	34	w.	8	10	16	4	4.9	.....	.....
Charleston	48	11	92	30.03	30.08	+ .07	77.6	−0.9	88	29	84	64	3	72	21	72	69	77	1.92	−3.5	9	7,361	s.	37	se.	3	16	9	5	4.0	.....	.....
Columbia, S. C.	351	41	57	29.68	30.05	+ .04	77.6	−0.6	97	24	87	59	17	68	26	68	64	67	4.95	+0.8	11	4,671	sw.	36	sw.	6	16	11	3	4.0	.....	.....
Augusta	180	62	77	29.86	30.05	+ .04	78.7	+0.6	98	24	90	60	20	68	30	70	67	70	2.88	−1.6	8	3,936	se.	39	n.	21	10	15	5	5.0	.....	.....
Savannah	65	150	194	30.01	30.08	+ .07	78.8	+0.6	95	23	87	60	19	70	28	71	69	79	3.72	−2.3	6	7,513	s.	33	n.	3	7	17	6	5.1	.....	.....
Jacksonville	43	200	245	30.03	30.08	+ .07	79.2	+0.2	94	23	87	62	20	71	23	71	68	77	3.03	−2.5	10	8,028	se.	48	ne.	4	6	16	8	5.8	.....	.....
Florida Peninsula.							**80.3**	**−0.1**										**75**	**4.57**	**−2.3**								**5.8**		
Key West	22	10	64	30.01	30.03	+0.04	81.6	−0.6	89	20	86	71	3	77	15	74	72	73	2.79	−1.5	11	6,984	e.	24	se.	21	11	9	10	5.4	.....	.....
Miami	25	71	79	30.04	30.07	.....	79.1	−1.3	86	20	84	69	15	75	15	73	71	77	6.71	−1.2	10	6,457	e.	25	e.	25	8	7	15	6.5	.....	.....
Sand Key	23	39	72	29.98	30.01	+ .02	79.9	.....	87	16	82	70	24	77	12	75	73	77	3.68	.....	10	9,314	e.	44	se.	20	12	9	9	4.7	.....	.....
Tampa	35	79	92	30.03	30.07	+ .06	80.3	+1.6	94	2	90	67	21	71	23	71	68	74	4.21	−4.1	9	4,249	ne.	27	ne.	12	4	12	14	6.4	.....	.....
East Gulf States.							**78.0**	**−0.3**										**67**	**2.29**	**−2.3**								**4.0**		
Atlanta	1,174	190	216	28.86	30.08	+0.07	75.0	−0.6	95	25	85	47	16	65	29	65	60	64	1.75	−2.1	9	6,299	nw.	44	sw.	21	13	10	7	4.6	.....	.....
Macon	370	78	87	29.68	30.07	+ .06	78.1	−1.0	97	24	90	50	16	66	31	67	63	64	0.40	−3.2	7	3,903	nw.	34	nw.	9	11	10	9	5.0	.....	.....
Thomasville	273	49	58	29.77	30.06	+ .06	79.4	−0.1	98	25	90	56	16	68	30	69	66	70	2.59	−2.1	11	2,834	sw.	22	e.	26	11	15	4	4.9	.....	.....
Pensacola	56	149	185	30.01	30.07	+ .08	77.4	−2.6	86	24	83	58	16	72	21	71	68	74	3.74	−1.1	6	8,095	sw.	47	e.	26	11	16	3	4.4	.....	.....
Anniston	741	9	57	29.30	30.08	+ .08	75.0	0.0	96	26	87	47	16	63	32	.....	.....	.....	5.97	+2.1	9	3,494	se.	25	nw.	7	12	16	2	4.0	.....	.....
Birmingham	700	11	48	29.32	30.08	+ .09	77.0	−1.2	95	24	88	47	16	66	29	66	62	67	3.44	−0.4	10	4,269	s.	23	nw.	26	13	15	2	3.9	.....	.....
Mobile	57	125	161	30.00	30.06	+ .07	78.9	−0.2	96	25	86	58	16	72	24	71	67	70	2.23	−3.7	6	6,865	sw.	37	sw.	11	14	11	5	4.1	.....	.....
Montgomery	223	100	112	29.82	30.06	+ .06	79.6	+0.5	98	24	91	52	16	68	30	68	62	62	1.33	−2.9	7	4,706	sw.	30	ne.	29	13	15	2	3.8	.....	.....
Corinth	469	6	....	.....	.....	.....	75.8	.....	98	25	88	46	16	64	36	.....	.....	.....	4.90	.....	9	.....	s.	.....	.....	.....	15	15	0	.....	.....	.....
Jackson	304	5	....	.....	.....	.....	79.6	.....	100	24	93	50	17	66	39	.....	.....	.....	2.74	.....	6	.....	s.	.....	.....	.....	11	18	1	.....	.....	.....
Meridian	375	85	93	29.65	30.03	+ .05	78.7	+1.4	98	24	90	52	16	67	31	67	61	59	0.21	−4.4	5	4,075	sw.	25	ne.	25	20	10	0	2.5	.....	.....
Vicksburg	247	65	74	29.78	30.06	+ .09	78.1	−0.4	94	12	88	54	17	68	27	69	64	65	0.80	−3.7	3	4,618	sw.	25	se.	26	19	11	0	2.8	.....	.....
New Orleans	51	76	84	30.00	30.05	+ .07	80.4	+0.8	94	11	89	62	16	72	22	72	69	74	2.77	−3.4	5	4,001	sw.	21	ne.	13	12	14	4	4.5	.....	.....
West Gulf States.							**79.4**	**+0.4**										**67**	**1.68**	**−2.0**								**3.1**		
Shreveport	249	77	93	29.76	30.02	+0.06	80.2	+0.6	102	30	91	56	16	69	31	68	62	59	0.49	−3.1	3	5,370	s.	24	s.	1	20	9	1	2.8	.....	.....
Bentonville	1,303	11	44	28.64	29.99	+ .05	71.5	−2.6	95	30	84	45	16	59	31	.....	.....	.....	3.71	−0.8	7	4,035	s.	36	se.	1	24	4	2	2.4	.....	.....
Fort Smith	457	79	94	29.51	29.98	+ .04	76.4	−0.4	100	30	88	52	16	65	30	66	62	66	2.57	−1.4	7	5,438	e.	43	sw.	21	17	10	3	3.3	.....	.....
Little Rock	357	139	147	29.65	30.02	+ .06	76.2	−1.0	96	30	86	53	16	66	26	69	66	72	3.82	−0.3	7	5,870	s.	48	nw.	8	15	10	5	3.6	.....	.....
Brownsville	57	4	26	.....	.....	.....	83.5	.....	98	30	93	62	16	74	29	.....	.....	.....	0.71	.....	1	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	.....
Corpus Christi	20	69	77	29.98	30.00	+ .09	80.8	+0.2	91	14	85	70	17	77	17	75	73	82	0.26	−2.5	3	12,685	se.	42	se.	5	5	24	1	4.8	.....	.....
Dallas	512	109	117	29.46	29.99	.....	81.2	.....	101	30	92	58	17	71	32	.....	.....	.....	0.46	.....	3	7,653	s.	62	s.	8	15	11	4	4.0	.....	.....
Fort Worth	670	106	114	29.26	29.96	+ .04	80.6	+ 0.5	100	30	92	58	2	70	31	66	58	53	1.97	− 1.0	3	7,382	s.	34	s.	5	16	10	4	3.9	.....	.....
Galveston	54	106	114	29.98	30.04	+ .09	80.3	− 0.6	89	30	84	68	17	76	14	73	71	76	0.65	− 4.1	1	8,867	s.	30	se.	1	25	5	0	1.9	.....	.....
Houston	138	111	121	29.88	30.02	.....	81.4	+ 0.4	97	30	91	62	17	72	27	.....	.....	.....	0.83	.....	3	6,274	se.	26	se.	1	23	7	0	2.5	.....	.....
Palestine	510	64	72	29.47	29.99	+ .05	80.7	+ 2.3	100	30	92	58	17	70	29	71	66	69	2.95	− 1.0	4	5,661	s.	39	s.	8	19	8	3	3.5	.....	.....
Port Arthur, Tex.	34	58	66	29.99	30.03	.....	79.4	.....	92	30	86	58	17	73	25	75	74	85	1.93	.....	1	7,448	s.	31	s.	1	17	13	0	2.9	.....	.....
San Antonio	701	119	132	29.25	29.96	+ .06	83.0	+ 2.6	100	11	95	62	17	71	31	70	64	61	0.02	− 3.1	1	6,594	s.	33	se.	28	28	2	0	1.5	.....	.....
Taylor	582	55	63	29.41	30.02	+ .10	81.9	+ 1.9	98	11	94	58	17	70	32	.....	.....	.....	0.31	− 3.2	1	8,115	s.	33	sw.	8	18	12	0	2.7	.....	.....

TABLE I.—*Climatological data for Weather Bureau stations, June, 1917*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.											Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.						Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.						
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	°*F.*	%	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
Ohio Valley and Tennessee.							**70.3**	**−2.8**											**71**	**4.41**	**+0.2**										**5.1**		
Chattanooga	762	189	213	29.27	30.07	+0.07	73.0	−2.4	96	26	83	49	16	63	29	65	62	72	5.71	+1.4	13	4,618	sw.	46	nw.	7	8	18	4	5.1	....	....
Knoxville	996	102	111	29.02	30.06	+ .06	71.4	−2.0	94	26	82	48	16	61	30	65	61	73	5.49	+1.3	11	4,120	s.	33	s.	19	6	16	8	5.5	....	....
Memphis	399	76	97	29.64	30.06	+ .09	76.1	−1.6	94	25	85	51	16	67	24	67	63	65	2.51	−1.9	6	5,551	sw.	56	nw.	8	19	8	3	3.0	....	....
Nashville	546	168	191	29.48	30.06	+ .07	73.0	−3.3	94	26	83	47	16	63	29	65	62	70	8.03	+3.7	13	5,250	s.	44	w.	20	15	8	7	4.1	....	....
Lexington	989	193	230	29.00	30.04	+ .04	70.0	−3.2	91	26	79	43	16	61	29	....	....	....	3.54	−0.4	10	8,406	sw.	60	sw.	1	15	8	7	4.3	....	....
Louisville	525	219	255	29.47	30.05	+ .07	72.0	−3.0	95	26	82	46	16	62	29	63	58	65	3.18	−1.0	9	7,893	sw.	44	w.	28	11	10	9	4.9	....	....
Evansville	431	139	175	29.57	30.03	+ .06	73.4	−1.9	98	26	83	46	16	64	29	64	59	65	4.20	0.0	9	7,361	s.	45	w.	28	11	17	2	4.5	....	....
Indianapolis	822	194	230	29.14	30.01	+ .04	68.8	−3.6	92	26	78	41	16	59	32	61	56	68	5.24	+0.9	15	8,293	sw.	44	sw.	7	9	13	8	5.8	....	....
Terre Haute	575	96	129	29.38	29.99	.....	69.6	.....	92	26	79	43	16	60	29	62	58	68	6.38	.....	11	7,066	sw.	35	sw.	7	4	21	5	5.7	....	....
Cincinnati	628	11	51	29.36	30.03	+ .04	69.0	−2.7	92	26	79	44	16	59	33	62	58	69	2.96	−1.0	10	4,616	sw.	32	sw.	7	10	10	10	5.0	....	....
Columbus	824	173	222	29.16	30.03	+ .04	67.8	−3.2	92	26	78	43	16	58	31	62	60	80	6.29	+2.8	14	7,417	sw.	48	w.	26	10	11	9	4.8	....	....
Dayton	899	181	216	29.06	30.00	.....	68.2	−4.0	92	26	78	43	16	58	29	62	59	77	4.20	+0.2	12	7,074	sw.	43	sw.	7	6	17	7	5.6	....	....
Pittsburgh	842	353	410	29.13	30.02	+ .03	67.6	−3.5	88	26	76	42	17	59	30	60	56	70	3.65	−0.2	13	6,939	sw.	64	nw.	23	4	12	14	6.6	....	....
Elkins	1,940	41	50	28.04	30.04	+ .04	65.0	−1.6	90	26	78	36	17	52	39	59	55	76	3.52	−1.5	16	2,290	w.	26	w.	7	6	11	13	6.5	....	....
Parkersburg	638	77	84	29.40	30.06	+ .06	68.6	−2.9	93	26	80	41	17	58	34	62	59	75	3.17	−1.5	16	3,557	se.	39	nw.	27	11	11	8	4.9	....	....
Lower Lake Region.							**63.5**	**−3.5**											**76**	**4.78**	**+1.2**										**6.0**		
Buffalo	767	247	280	29.17	29.99	+0.02	60.2	−4.9	82	12	67	45	16	53	25	56	53	80	5.28	+2.1	15	11,123	sw.	68	sw.	13	7	9	14	6.3	....	....
Canton	448	10	61	29.48	29.96	.....	62.0	−3.8	88	13	71	44	6	53	29	....	....	....	3.58	+0.2	13	7,258	sw.	39	w.	3	12	13	5	4.6	....	....
Oswego	335	76	91	29.62	29.98	+ .01	59.6	−4.2	85	13	68	43	6	51	27	55	52	80	3.79	+0.4	16	5,819	w.	28	sw.	29	6	10	14	6.0	....	....
Rochester	523	97	113	29.44	30.00	+ .03	62.8	−3.3	89	13	72	47	17	54	30	56	53	74	6.40	+3.3	19	5,752	sw.	37	sw.	29	5	9	16	6.6	....	....
Syracuse	597	97	113	29.36	30.01	+ .04	63.4	−3.5	83	13	72	45	17	55	25	57	54	75	4.46	+0.6	17	6,816	s.	36	w.	29	2	15	13	6.6	....	....
Erie	714	130	166	29.23	30.00	+ .02	63.6	−3.4	87	13	72	48	17	56	29	58	55	75	6.35	+2.6	17	8,275	sw.	46	sw.	3	2	17	11	6.3	....	....
Cleveland	762	190	201	29.19	30.01	+ .03	64.8	−3.1	88	26	73	45	17	57	29	59	56	75	3.59	−0.1	16	8,345	sw.	58	nw.	23	6	16	8	6.2	....	....
Sandusky	629	62	103	29.32	30.00	+ .02	66.0	−2.8	91	26	75	47	16	57	29	60	56	74	4.21	+0.4	12	7,903	sw.	38	nw.	19	3	18	9	6.1	....	....
Toledo	628	208	243	29.32	30.00	+ .03	66.1	−3.3	89	26	75	46	16	57	32	60	56	72	5.32	+1.9	12	9,460	sw.	48	sw.	7	9	13	8	5.1	....	....
Fort Wayne	856	113	124	29.10	30.02	.....	66.0	−2.5	89	26	75	40	16	56	31	60	57	77	4.63	.....	14	6,511	sw.	39	w.	2	5	13	12	6.2	....	....
Detroit	730	218	245	29.21	30.00	+ .03	64.0	−3.8	87	26	72	45	16	56	30	58	54	73	4.78	+0.9	14	7,905	sw.	46	w.	2	6	14	10	6.0	....	....
Upper Lake Region.							**57.7**	**−4.8**											**77**	**4.19**	**+0.9**										**6.0**		
Alpena	609	13	92	29.31	29.97	+0.01	56.2	−4.1	85	12	65	39	16	48	31	53	49	77	3.50	0.0	18	7,813	se.	46	e.	6	9	13	8	5.2	....	....
Escanaba	612	54	60	29.29	29.95	+ .01	54.4	−6.2	80	12	62	39	15	47	29	51	49	82	5.30	+1.7	15	6,560	s.	38	e.	6	11	7	12	5.7	....	....
Grand Haven	632	54	92	29.28	29.96	.00	58.6	−6.1	81	12	67	38	16	50	28	54	51	77	4.04	+1.5	15	8,027	s.	39	nw.	2	8	12	10	5.6	....	....
Grand Rapids	707	70	87	29.21	29.98	+ .01	62.6	−5.5	85	12	72	39	16	53	31	57	54	75	3.44	+0.9	15	4,631	w.	23	nw.	14	5	13	12	6.8	....	....
Hougton	684	62	99	29.20	29.93	− .01	54.0	−5.4	80	10	64	35	2	44	32	....	....	....	2.07	−1.4	14	7,592	e.	48	ne.	6	10	9	11	5.8	....	....
Lansing	878	11	62	29.04	29.98	.....	62.4	−5.0	85	12	73	39	16	52	35	57	54	77	4.54	+1.1	12	4,213	sw.	23	sw.	2	4	10	16	6.9	....	....
Ludington	637	60	66	29.26	29.96	.....	56.3	.....	74	12	64	40	16	49	26	54	51	84	3.68	.....	15	7,492	s.	40	s.	13	8	12	10	5.5	....	....
Marquette	734	77	111	29.18	29.98	+ .04	52.0	−6.5	82	12	61	33	2	43	38	48	44	75	2.48	−1.0	18	5,310	nw.	36	sw.	13	6	9	15	6.6	....	....
Port Huron	638	70	120	29.29	29.98	+ .01	60.3	−3.5	83	26	70	41	16	51	29	55	52	76	4.32	+1.1	9	7,324	sw.	38	nw.	13	6	19	5	5.3	....	....
Saginaw	641	48	82	29.28	29.98	.....	61.9	.....	86	12	72	42	16	52	33	56	52	71	4.93	+2.3	14	6,552	sw.	30	e.	6	4	11	15	6.7	....	....
Sault Sainte Marie	614	11	61	29.28	29.98	+ .02	52.5	−5.1	82	11	62	33	16	43	34	49	46	78	4.27	+1.5	17	5,856	w.	41	nw.	13	4	13	13	6.7	....	....
Chicago	823	140	310	29.10	29.98	+ .02	63.8	−2.5	86	26	72	45	2	55	27	57	53	71	2.87	−0.8	11	9,263	sw.	50	w.	12	8	9	13	5.8	....	....
Green Bay	617	109	144	29.26	29.92	− .03	60.6	−4.6	82	12	68	44	3	53	30	55	52	76	4.92	+1.4	13	8,428	s.	48	n.	2	6	13	11	6.6	....	....
Milwaukee	681	119	133	29.22	29.95	.00	60.0	−3.5	85	26	68	44	2	52	28	56	54	83	10.03	+6.4	12	7,041	sw.	46	sw.	6	10	9	11	5.8	....	....
Duluth	1,133	11	47	28.73	29.94	+ .02	53.0	−4.7	82	18	63	36	1	43	40	48	44	75	1.93	−2.6	13	8,806	ne.	52	ne.	6	10	9	11	5.6	....	....
North Dakota.							**60.7**	**−3.0**											**60**	**1.93**	**−1.8**										**4.3**		
Moorhead	940	8	57	28.92	29.93	+0.03	61.2	−3.1	95	17	75	34	1	48	42	55	49	65	1.52	−2.6	10	6,124	s.	38	nw.	13	21	2	7	2.9	....	....
Bismarck	1,674	8	57	28.18	29.95	+ .08	61.9	−2.3	93	17	75	38	21	49	39	53	45	60	2.15	−1.4	11	8,290	nw.	50	sw.	10	10	15	5	4.4	....	....
Devils Lake	1,482	11	44	28.33	29.88	.00	59.2	−3.4	94	17	72	31	4	46	41	51	43	57	1.69	−1.8	16	8,238	nw.	40	nw.	13	12	7	11	5.4	....	....
Grand Forks	835	12	89	.....	.....	.....	59.4	.....	90	17	73	28	1	46	42	....	....	....	1.95	.....	10	.....	se.	51	ne.	16	19	7	4	.....	....	....
Williston	1,872	41	48	27.94	29.89	+ .03	60.4	−3.1	91	9	73	33	1	48	38	51	43	58	2.36	−1.2	14	7,655	w.	50	nw.	9	9	18	3	4.6	....	....
Upper Mississippi Valley.							**67.4**	**−3.5**											**72**	**5.43**	**+1.1**										**5.4**		
Minneapolis	918	10	208	28.93	29.90	.....	63.3	.....	88	30	73	43	15	54	30	....	....	....	3.77	−0.2	13	8,438	nw.	47	se.	11	9	14	7	5.6	....	....
St. Paul	837	201	236	29.01	29.91	−0.01	62.8	−4.6	88	30	72	42	15	53	33	....	....	....	3.79	−0.6	13	8,913	nw.	52	nw.	13	5	20	5	5.2	....	....
La Crosse	714	11	48	29.15	29.91	− .02	63.1	−5.1	85	25	73	45	16	53	30	....	....	....	5.79	+1.4	16	3,527	nw.	22	w.	28	5	10	15	6.5	....	....
Madison	974	70	78	28.92	29.96	+ .02	61.8	−5.5	82	26	70	43	15	54	24	57	54	79	6.47	+2.4	16	6,846	s.	44	sw.	6	4	10	16	7.1	....	....
Wausau	1,247	4	....	28.61	29.93	.....	58.2	.....	82	10	68	36	3	48	38	....	....	....	2.97	.....	14	.....	nw.	....	....	....	....	7	10	13	6.2	....	....
Charles City	1,015	10	49	28.87	29.93	+ .02	63.7	−5.1	90	30	74	38	15	53	33	58	55	75	4.96	−0.1	15	5,070	nw.	33	se.	4	6	15	9	5.9	....	....
Davenport	606	71	79	29.30	29.95	+ .01	67.6	−3.3	90	25	77	45	15	58	25	61	58	73	4.85	+0.7	15	5,884	sw.	39	sw.	6	6	11	13	6.3	....	....
Des Moines	861	84	97	29.03	29.92	.00	67.9	−2.5	95	30	78	47	15	58	28	61	56	68	8.16	+3.2	15	5,907	n.	36	sw.	30	8	10	12	5.5	....	....
Dubuque	698	81	96	29.22	29.96	+ .03	65.2	−4.4	87	30	74	47	3	56	28	58	54	71	5.12	+0.6	17	5,122	nw.	30	sw.	6	6	13	11	6.1	....	....
Keokuk	614	64	78	29.30	29.96	+ .02	68.9	−3.6	91	25	78	46	15	60	27	63	59	70	7.35	+3.0	10	6,155	sw.	46	w.	27	11	16	3	3.9	....	....
Cairo	356	87	93	29.63	30.01	+ .04	74.2	−1.0	94	26	83	50	16	65	27	66	62	70	3.15	−1.2	9	5,677	s.	39	sw.	1	9	16	5	4.6	....	....
Peoria	609	11	45	29.32	29.99	+ .04	67.7	−3.2	91	25	78	40	16	58	29	62	59	74	7.43	+3.1	11	5,079	s.	34	sw.	2	7	16	7	5.3	....	....
Springfield, Ill	644	10	91	29.30	29.97	+ .02	69.7	−2.6	94	25	79	44	16	60	30	64	61	75	10.77	+6.5	12	6,173	s.	33	sw.	2	12	12	6	4.8	....	....
Hannibal	534	74	109	29.40	29.97	+ .02	70.4	−2.9	92	30	80	43	16	61	27	....	....	....	3.75	+0.2	10	7,021	sw.	39	sw.	6	15	10	5	3.8	....	....
St. Louis	567	265	303	29.39	29.98	+ .03	73.3	−1.8	94	26	82	49	16	64	25	64	59	64	0.62	−3.8	8	9,825	s.	43	sw.	6	11	7	2	4.6	....	....
Missouri Valley.							**68.8**	**−2.1**											**63**	**3.18**	**−1.2**										**3.7**		
Columbia, Mo	781	11	84	29.15	29.97	+0.02	70.9	−3.6	96	30	82	46	16	60	29	....	....	....	2.66	−1.7	10	5,469	s.	34	nw.	26	15	11	4	3.7	....	....
Kansas City	963	161	181	28.93	29.94	+ .02	72.7	−0.3	102	30	83	52	16	62	30	63	57	61	3.34	−1.3	7	8,978	s.	38	n.	13	20	9	1	2.8	....	....
St. Joseph	967	11	49	28.93	29.94	.....	72.0	.....	101	30	83	49	15	61	29	62	57	66	6.21	.....	8	6,455	s.	44	nw.	5	17	9	4	3.1	....	....
Springfield, Mo	1,324	98	104	28.62	30.01	+ .06	70.9	−1.4	94	30	81	48	15	61	26	63	58	68	2.69	−2.5	5	7,495	s.	60	se.	1	23	5	2	2.3	....	....
Iola	984	11	50	28.93	29.96	+ .03	73.2	−0.2	102	30	86	45	15	61	32	....	....	....	0.94	−3.8	6	5,287	s.	30	sw.	11	19	11	0	2.2	2.5	....
Topeka	987	85	101	.....	.....	.....	72.6	−0.9	102	30	84	48	15	62	29	....	....	....	3.04	−1.8	8	7,919	se.	60	sw.	5	18	10	2	2.9	....	....
Drexel	1,299	10	54	28.56	29.93	.....	67.2	.....	97	30	78	42	15	57	34	60	55	69	7.12	.....	17	8,232	nw.	56	nw.	22	16	7	7	4.2	....	....
Lincoln	1,189	11	84	28.68	29.91	+ .01	69.7	−1.9	102	30	81	45	15	59	34	61	55	63	6.03	+1.7	14	8,372	s.	47	nw.	5	18	6	6	3.7	....	....
Omaha	1,105	115	122	28.77	29.93	+ .02	69.6	−2.0	100	30	79	49	15	60	33	62	57	67	6.19	+1.1	15	6,471	nw.	36	nw.	6	15	8	7	4.1	....	....
Valentine	2,598	47	54	27.28	29.96	+ .10	64.3	−2.8	99	24	78	37	2	51	43	55	48	60	1.13	−2.7	10	7,505	nw.	41	nw.	17	16	11	3	4.2	....	....
Sioux City	1,135	94	164	28.74	29.93	+ .03	67.4	−2.0	91	22	77	43	15	58	32	60	54	66	3.91	0.0	15	9,282	nw.	85	w.	22	15	9	6	4.1	....	....
Huron	1,306	59	74	28.56	29.95	+ .07	63.2	−3.4	93	17	74	39	1	52	36	56	50	65	2.40	−1.4	10	7,708	nw.	46	sw.	10	11	15	4	4.3	....	....
Pierre	1,572	70	75	28.29	29.93	+ .06	65.3	−3.6	97	17	77	42	1	54	39	56	50	61	0.84	−2.2	8	6,928	nw.	47	nw.	22	18	2	10	4.3	....	....
Yankton	1,233	49	57	28.61	29.90	+ .01	66.4	−3.0	95	17	76	40	15	56	36	....	....	....	5.05	+0.8	13	5,716	se.	36	sw.	22	9	13	8	5.3	....	....

TABLE I.—*Climatological data for Weather Bureau stations, June, 1917*—Continued.

Districts and stations.	Elevation of instruments.			Pressure.			Temperature of the air.												Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation.			Wind.						Clear days.	Partly cloudy days.	Cloudy days.	A verage cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.							Total.	Departure from normal.	Days with 0.01 inch or more.	Total movement.	Prevailing direction.	Maximum velocity.									
																										Miles per hour.	Direction.	Date.							
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°*F.*	°*F.*	°*F*		°*F*	°*F.*		°*F*	°*F.*	°*F.*	°*F.*	°*F.*			%	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
Northern Slope.							**59.1**	**−3.0**													**56**	**1.45**	**−0.9**										**4.1**		
Billings	3,140	5					61.0		92	15	76	33	1	46	46						2.17		7		sw.				14	12	4			
Havre	2,505	11	44	27.33	29.94	+0.09	59.6	−2.8	88	16	72	30	3	47	40	50	43	59			1.43	−1.4	10	6,267	sw.	39	sw.	28	15	12	3	4.1		
Helena	4,110	87	112	25.83	29.98	+ .10	57.8	−2.8	88	28	70	34	12	45	40	46	36	50			1.25	−0.9	8	6,531	sw.	50	sw.	1	10	17	3	4.7		
Kalispell	2,962	11	34	26.96	29.99	+ .10	55.5	−3.3	89	16	68	33	3	43	41	46	39	62			2.76	+1.0	11	3,762	sw.	33	sw.	28	8	15	7	5.4		
Miles City	2,371	48	55	27.46	29.98	+ .13	63.2	−2.8	94	9	76	34	1	50	38	54	48	64			1.99	−0.8	9	4,813	w.	30	n.	30	15	11	4	3.6		
Rapid City	3,259	50	58	26.62	29.99	+ .15	61.2	−2.6	98	29	74	32	1	49	43	51	42	52			2.13	−1.5	14	6,476	w.	36	sw.	9	10	15	5	4.2		
Cheyenne	6,088	84	101	24.07	29.95	+ .11	58.2	−3.3	88	29	72	30	1	44	37	48	39	54			0.34	−1.2	4	9,002	w.	65	w.	11	10	18	2	4.0	T.	
Lander	5,372	60	68	24.69	29.96	+ .11	58.4	−2.9	88	28	74	27	13	43	42	45	31	42			0.13	−1.0	4	4,069	w.	30	sw.	10	17	10	3	3.4		
Sheridan	3,790	10	47	26.13	29.99		58.0		90	24	73	29	1	43	46	49	42	59			1.02		11	4,249	nw.	31	nw.	10	15	5	10	4.5		
Yellowstone Park	6,200	11	48	23.94	29.99	+ .13	50.8	−5.2	80	28	65	28	3	37	40	40	30	49			0.67	−1.0	7	5,789	sw.	37	s.	9	13	14	3	4.1	1.7	
North Platte	2,821	11	51	27.08	29.98	+ .12	67.0	−1.4	98	24	82	33	2	52	42	58	53	65			2.38	−0.9	8	5,541	w.	38	nw.	22	20	7	3	2.9		
Middle Slope.							**71.7**	**−0.1**													**51**	**1.20**	**−2.0**										**2.8**		
Denver	5,292	106	113	24.77	29.94	+0.10	65.6	−0.8	95	29	79	33	1	52	35	52	41	47			0.41	−1.1	2	5,365	se.	47	n.	30	19	8	3	2.8	T.	
Pueblo	4,685	80	86	25.32	29.93	+ .10	67.2	−1.8	100	29	84	37	2	51	42	51	38	43			0.58	−0.9	5	4,627	nw.	31	w.	10	15	13	2	3.1		
Concordia	1,392	50	58	28.49	29.93	+ .03	72.6	−0.1	104	30	85	48	1	60	37	61	53	56			3.17	−1.8	5	6,849	s.	50	n.	5	15	13	2	3.7		
Dodge City	2,509	11	51	27.38	29.92	+ .05	73.4	+0.3	104	10	89	36	2	58	41	58	48	49			0.91	−2.4	4	7,997	s.	52	nw.	5	25	3	2	2.7		
Wichita	1,358	139	158	28.52	29.92	+ .01	74.8	+0.5	100	30	87	49	2	63	32	62	55	57			0.32	−4.4	4	10,716	s.	70	nw.	5	22	7	1	2.0		
Altus	1,410	5					79.4		108	12	95	45	2	64	42						0.30		3		se.				22	7	1			
Muskogee	652	4					76.0		102	30	88	48	16	63	32						2.91		4		se.				21	6	3			
Oklahoma	1,214	10	47	28.70	29.95	+ .04	76.9	+1.2	100	30	91	46	2	63	38	63	55	54			1.83	−1.2	5	10,756	s.	48	n.	13	21	9	0	2.2		
Southern Slope.							**78.0**	**+0.8**													**39**	**0.70**	**−0.2**										**2.2**		
Abilene	1,738	10	52	28.16	29.92	+0.04	80.2	+2.0	104	8	93	53	16	68	34	64	52	45			0.69	−2.5	2	8,340	s.	47	nw.	1	17	9	4	3.2		
Amarillo	3,676	10	49	26.29	29.94	+ .09	73.6	+1.6	100	12	89	38	2	58	40	57	45	45			0.83	−2.2	3	8,972	se.	40	n.	13	23	7	0	2.2		
Del Rio	944	64	71	28.96	29.92	+ .07	83.4	+1.3	101	10	94	65	18	73	29						1.29	−1.2	3	8,227	e.	40	e.	28	20	8	2	2.3		
Roswell	3,566	75	85	26.36	29.88	+ .08	74.8	−1.5	102	12	91	45	2	58	46	53	33	28			T.	−2.1	0	6,047	s.	40	ne.	13	26	4	0	1.2		
Southern Plateau.							**75.5**	**+0.7**													**28**	**0.10**	**−0.3**										**1.2**		
El Paso	3,762	110	133	26.16	29.81	+0.06	80.8	+1.2	99	21	94	53	1	68	37	54	28	19			0.36	−0.2	2	8,061	w.	46	ne.	13	25	5	0	1.6		
Santa Fe	7,013	57	66	23.32	29.83	+ .02	66.0	−0.2	89	30	79	38	1	53	34	46	28	28			0.06	−1.0	1	6,379	sw.	36	sw.	10	16	14	0	3.1		
Flagstaff	6,908	8	57	23.44	29.88	+ .10	59.0	−0.3	87	30	78	25	2	40	45	42					0.00		0		w.	50	w.	10	29	1	0			
Phoenix	1,108	76	81	28.66	29.78	+ .04	84.4	0.0	112	16	103	50	1	65	48	61	45	30			0.00	−0.1	0	3,547	w.	21	s.	30	30	0	0	0.2		
Yuma	141	9	54	29.64	29.78	+ .04	87.4	+2.7	119	16	106	57	1	68	48	65	50	37			0.00	0.0	0	3,340	sw.	27	s.	30	30	0	0	0.0		
Independence	3,910	11	42																															
Needles	488	4		29.25	29.73		87.4		120	17	109	54	1	66	52						0.00		0						29	1	0			
Middle Plateau.							**65.2**	**−0.5**													**33**	**0.10**	**−0.4**										**1.2**		
Reno	4,532	74	81	25.52	29.96	+0.10	63.8	+2.8	91	19	81	36	12	46	47	46	32	39			0.06	−0.2	1	5,637	w.	36	w.	9	29	1	0	0.5		
Tonopah	6,090	12	20	24.12	29.92		67.2		89	17	80	35	12	55	35	47	27	25			0.00	−0.4	0	6,089	w.	34	w.	9	26	4	0	1.0		
Winnemucca	4,344	18	56	25.66	30.00	+ .12	63.3	0.0	92	16	80	32	12	46	42	46	31	40			0.35	−0.3	2	4,422	sw.	36	sw.	9	27	3	0	1.1		
Modena	5,479	10	43	24.65	29.92	+ .10	62.8	−0.4	92	16	82	30	13	44	49	45	25	32			T.	−0.4	0	8,053	sw.	49	sw.	9	29	1	0	0.9		
Salt Lake City	4,360	163	203	25.65	29.96	+ .11	65.8	−2.5	92	28	77	41	11	55	32	49	34	36			0.19	−0.6	2	5,806	nw.	35	sw.	9	21	6	3	2.6		
Grand Junction	4,602	82	96	25.39	29.91	+ .08	70.2	−2.4	98	29	86	42	6	55	38	50	30	28			0.01	−0.4	1	5,785	nw.	35	nw.	4	26	4	0	1.4		
Northern Plateau.							**61.3**	**−3.6**													**47**	**0.52**	**−0.6**										**4.0**		
Baker	3,471	48	53	26.51	30.08	+0.13	55.8	−2.8	88	16	70	31	2	42	41	45	36	54			0.23	−1.0	4	4,570	nw.	24	nw.	1	17	9	4	3.5	T.	
Boise	2,739	78	86	27.20	30.04	+ .13	62.6	−3.4	96	16	77	34	11	48	40	49	36	45			0.34	−0.5	3	4,154	nw.	29	nw.	1	16	10	4	3.8		
Lewiston	757	40	48	29.24	30.05	+ .11	63.6	−5.5	96	15	78	40	4	49	42						0.48	−0.6	7	3,028	ne.	31	nw.	28	13	10	7	4.3		
Pocatello	4,477	60	68	25.51	29.98	− .11	60.6	−3.6	89	28	74	33	12	47	39	47	33	41			0.52	−0.5	5	6,362	se.	40	sw.	9	19	9	2	3.1	T.	
Spokane	1,929	101	110	28.00	30.04	+ .10	60.2	−3.2	90	15	72	40	2	48	35	48	38	51			1.00	−0.6	8	5,601	sw.	33	w.	28	7	17	6	5.5		
Walla Walla	991	57	65	28.99	30.05	+ .09	64.8	−3.4	95	15	77	44	3	53	35	52	40	46			0.57	−0.6	8	4,076	s.	26	sw.	28	15	12	3	3.7		
North Pacific Coast Region.							**56.5**	**−1.1**													**76**	**2.05**	**0.0**										**5.4**		
North Head	211	11	56	29.93	30.16	+0.17	53.3	−1.7	72	13	57	44	11	50	19	52	50	92			2.26	+0.5	14	10,940	nw.	72	se.	23	7	9	14	6.1		
North Yakima	1,071	4					63.0		94	15	78	40	12	48	40						0.28		3		nw.				19	9	2			
Port Angeles	42	8	53	30.15	30.18		52.5		73	27	60	39	12	45	30						0.95	−0.4	11	5,420	nw.	37	w.	16	8	12	10	5.6		
Seattle	125	215	250	30.02	30.14	+ .14	57.2	−2.9	84	13	65	44	10	49	31	51	46	73			3.70	+2.0	12	6,239	s.	44	sw.	16	8	7	15	6.1		
Tacoma	213	113	120	29.91	30.14	+ .11	57.4	−2.0	87	13	66	43	10	49	36	53	49	78			3.07	+0.9	11	4,812	n.	32	sw.	24	4	13	13	6.7		
Tatoosh Island	109	7	57	30.04	30.14	+ .12	51.6	−1.4	66	13	55	43	11	48	17	49	48	88			2.91	−1.3	11	7,936	sw.	43	ne.	13	8	7	15	5.8		
Medford	1,425	4					63.2		96	15	82	32	12	44	52						0.06		1		nw.				22	6	2			
Portland, Oreg	153	68	106	29.96	30.12	+ .08	61.8	+0.3	90	13	72	43	12	52	32	53	46	63			1.17	−0.6	13	4,580	nw.	33	sw.	23	11	9	10	5.2		
Roseburg	510	9	57	29.58	30.12	+ .10	62.1	+1.2	94	15	77	37	12	47	48	52	44	61			0.26	−0.8	3	2,661	n.	26	sw.	23	20	10	0	2.2		
Middle Pacific Coast Region.							**62.9**	**+0.3**													**55**	**0.00**	**−0.4**										**1.4**		
Eureka	62	73	89	30.09	30.16	+0.11	52.6	−2.0	68	23	58	41	12	48	23	50	47	85			0.00	−1.1	0	5,579	n.	29	nw.	29	13	12	5	4.1		
Mount Tamalpais	2,375	11	18	27.57	30.01	+ .06	65.2	+1.1	91	18	74	42	10	56	28	49	33	36			0.00	−0.4	0	15,549	nw.	84	nw.	9	30	0	0	0.5		
Point Reyes Light	490	7	18	29.46	29.98		50.6	−2.2	68	15	56	40	10	46	24						0.00		0	22,719	nw.	66	nw.	11	17	7	6	3.6		
Red Bluff	332	50	56	29.58	29.93	+ .05	76.9	+1.2	105	18	92	53	10	62	40	56	35	28			0.00	−0.5	0	4,628	nw.	26	nw.	19	30	0	0	0.2		
Sacramento	69	106	117	29.87	29.94	+ .05	72.6	+3.7	105	18	90	46	10	56	43	59	48	54			0.00	−0.2	0	5,963	s.	29	s.	9	30	0	0	0.1		
San Francisco	155	209	213	29.84	30.01	+ .05	58.6	+1.6	87	15	67	46	8	50	40	52	47	74			T.	−0.2	0	8,249	sw.	34	sw.	9	26	3	1	1.0		
San Jose	141	12	110	29.86	30.01		63.9	−1.1	96	18	80	42	11	48	46						0.00	−0.1	0	4,489	nw.	24	nw.	11	30	0	0	0.5		
South Pacific Coast Region.							**68.5**	**+2.4**													**61**	**0.00**	**−0.1**										**1.9**		
Fresno	327	89	98	29.56	29.91	+0.06	77.0	+1.2	108	16	94	49	4	60	42	56	37	31			0.00	−0.1	0	7,151	nw.	31	nw.	9	30	0	0	0.1		
Los Angeles	338	159	191	29.57	29.93	+ .03	68.6	+4.1	105	17	79	49	1	58	36	60	55	71			0.00	−0.1	0	3,655	sw.	16	sw.	27	18	12	0	2.7		
San Diego	87	62	70	29.85	29.94	+ .02	63.7	−0.1	87	14	70	54	8	58	26	59	56	82			T.	0.0	0	4,295	w.	20	nw.	14	16	13	1	3.6		
San Luis Obispo	201	32	40	29.79	30.00	+ .05	64.8	+4.4	110	15	80	43	12	50	57	53	46	60			0.00	−0.1	0	3,285	nw.	18	n.	17	26	4	0	1.3		
West Indies.																																		
San Juan, P. R.	82	8	54	29.93	30.02	+0.03	79.1		91	16	84	72	1	74	16	75	73	80			4.87	−1.0	17	8,543	e.	46	e.	27	8	12	10	5.7		
Panama Canal.																																		
Balboa Heights	118	7	97	29.75	29.87		79.0		90	9	85	70	1	73	17	75	74	91			7.35	−0.3	20	3,753	nw.	32	e.	28	0	5	25	8.1		
Colon	25	5	71	29.83	29.87		78.7		88	6	83	68	19	74	14	75	74	88			14.37	+0.9	19	4,458	se.	30	n.	13	1	9	20	7.7		
Alaska.																																		
Juneau	80	11	49				51.9		75	13	58	40	2	45	32	48	44	79			5.30		18	2,712	s.	20	s.	14	2	6	22	8.3		

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during June, 1917, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.														
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex.	1			0.67														0.41			
Albany, N. Y.	7			0.72														0.31			
Alpena, Mich.	2			0.37														0.22			
Amarillo, Tex.	19			0.54														0.31			
Anniston, Ala.	9	1:38 p. m.	4:45 p. m.	1.61	1:40 p. m.	2:38 p. m.	0.01	0.34	0.51	0.55	0.58	0.68	0.97	1.01	1.01	1.02	1.04	1.41			
	21	2:15 p. m.	3:45 p. m.	1.24	2:28 p. m.	3:09 p. m.	0.04	0.08	0.22	0.40	0.61	0.83	0.98	1.03							
	29	12:57 p. m.	1:15 p. m.	0.73	12:57 p. m.	1:08 p. m.	0.00	0.31	0.64	0.72											
Asheville, N. C.	9	12:02 p. m.	12:55 p. m.	0.59	12:19 p. m.	12:41 p. m.	0.02	0.09	0.16	0.42	0.53	0.56									
	21	1:25 p. m.	3:50 p. m.	0.85	1:28 p. m.	1:46 p. m.	0.01	0.14	0.34	0.54	0.60										
	27	2:45 p. m.	4:10 p. m.	0.66	2:52 p. m.	3:20 p. m.	0.01	0.12	0.33	0.49	0.54	0.59	0.62								
Atlanta, Ga.	9			0.79														0.38			
Atlantic City, N. J.	7			1.30														0.53			
Augusta, Ga.	28	5:45 p. m.	7:15 p. m.	0.70	6:11 p. m.	6:36 p. m.	0.08	0.15	0.32	0.40	0.48	0.60									
Baker, Oreg.	3			0.10														*			
Baltimore, Md.	6	5:58 p. m.	9:30 p. m.	0.97	6:04 p. m.	6:29 p. m.	0.01	0.13	0.37	0.58	0.69	0.74									
Bentonville, Ark.	5	8:30 p. m.	9:15 p. m.	0.76	8:43 p. m.	9:07 p. m.	0.01	0.22	0.36	0.44	0.61	0.73									
Binghamton, N. Y.	6–7	9:52 p. m.	1:00 a. m.	1.81	10:49 p. m.	12:18 a. m.	0.07	0.11	0.23	0.29	0.36	0.43	0.44	0.45	0.47	0.54	0.75	0.96	1.25	1.69	
	20	5:25 p. m.	6:10 p. m.	0.70	5:39 p. m.	6:00 p. m.	0.05	0.30	0.39	0.47	0.63	0.65									
Birmingham, Ala.	7	2:54 a. m.	D. N. a. m.	0.80	2:58 a. m.	3:11 a. m.	0.01	0.37	0.66	0.78											
	26	1:03 p. m.	1:46 p. m.	0.53	1:12 p. m.	1:20 p. m.	0.01	0.36	0.50												
Bismarck, N. Dak.	10			0.65														0.31			
Block Island, R. I.	29			0.38														0.37			
Boise, Idaho.	11			0.15														0.09			
Boston, Mass.	11			0.72														0.52			
Buffalo, N. Y.	6	6:28 p. m.	11:00 p. m.	1.04	7:22 p. m.	7:58 p. m.	0.11	0.23	0.40	0.44	0.50	0.56	0.63	0.79	0.82						
	26	4:05 p. m.	6:50 p. m.	0.65	4:08 p. m.	4:20 p. m.	0.01	0.32	0.46	0.51											
Burlington, Vt.	8			0.41														0.31			
Cairo, Ill.	8			1.12														0.51			
Canton, N. Y.	10–11			1.47														0.45			
Charles City, Iowa.	6			2.06														0.53			
Charleston, S. C.	3–4	8:03 p. m.	D. N. a. m.	1.30	8:06 p. m.	8:28 p. m.	0.02	0.08	0.23	0.42	0.55	0.61									
Charlotte, N. C.	9–10	6:39 p. m.	D. N. a. m.	1.69	6:41 p. m.	7:15 p. m.	0.01	0.33	0.47	0.66	0.74	0.85	0.95	0.98							
	10	1:56 p. m.	2:34 p. m.	0.57	1:58 p. m.	2:11 p. m.	0.01	0.16	0.45	0.52											
	27	7:02 p. m.	8:51 p. m.	0.94	7:15 p. m.	7:42 p. m.	0.02	0.15	0.44	0.59	0.65	0.76	0.82								
Chattanooga, Tenn.	14	4:21 a. m.	6:32 a. m.	1.04	4:30 a. m.	4:55 a. m.	0.01	0.40	0.65	0.77	0.83	0.93									
	27	3:18 p. m.	8:25 p. m.	1.08	4:10 p. m.	4:38 p. m.	0.08	0.07	0.11	0.30	0.60	0.81	0.85								
Cheyenne, Wyo.	26			0.21														0.10			
Chicago, Ill.	28			0.58														0.54			
Cincinnati, Ohio.	5			0.89														0.39			
Cleveland, Ohio.	23	6:24 p. m.	7:07 p. m.	0.89	6:30 p. m.	6:44 p. m.	0.01	0.15	0.57	0.87											
Columbia, Mo.	23	5:30 a. m.	8:39 a. m.	0.90	6:24 a. m.	7:11 a. m.	0.13	0.05	0.13	0.20	0.31	0.43	0.47	0.57	0.58	0.69	0.71				
Columbia, S. C.	1	8:45 p. m.	10:15 p. m.	0.63	8:52 p. m.	9:20 p. m.	0.01	0.16	0.26	0.37	0.47	0.56	0.61								
	9	9:03 p. m.	11:25 p. m.	1.01	9:22 p. m.	9:50 p. m.	0.06	0.22	0.34	0.45	0.56	0.62	0.66								
	14–15	7:45 p. m.	D. N. a. m.	1.24	8:45 p. m.	9:05 p. m.	0.07	0.13	0.28	0.54	0.60										
Columbus, Ohio.	9	8:15 p. m.	10:40 p. m.	0.67	8:23 p. m.	8:36 p. m.	0.02	0.34	0.51	0.57											
Concord, N. H.	3	8:41 a. m.	10:20 a. m.	0.64	8:47 a. m.	9:01 a. m.	T.	0.33	0.48	0.51											
Concordia, Kans.	5	3:40 a. m.	4:10 a. m.	1.26	3:44 a. m.	4:03 a. m.	0.01	0.19	0.56	0.98	1.24										
Corpus Christi, Tex.	25			0.16														0.16			
Dallas, Tex.	25			0.30														0.17			
Davenport, Iowa.	5			0.92														0.60			
Dayton, Ohio.	28	3:16 p. m.	6:05 p. m.	0.65	3:20 p. m.	3:35 p. m.	0.01	0.18	0.38	0.50											
Del Rio, Tex.	24	7:20 p. m.	10:45 p. m.	1.05	7:25 p. m.	7:54 p. m.	0.01	0.14	0.39	0.53	0.65	0.73	0.77								
Denver, Colo.	5			0.33														0.12			
Des Moines, Iowa.	4	7:08 a. m.	12:55 p. m.	1.18	8:10 a. m.	8:55 a. m.	0.05	0.18	0.36	0.39	0.48	0.54	0.58	0.65	0.72	0.77					
	8	4:41 p. m.	10:05 p. m.	1.40	6:08 p. m.	7:06 p. m.	0.06	0.12	0.15	0.17	0.41	0.52	0.81	0.97	1.11	1.16	1.23	1.31			
Detroit, Mich.	26	D. N. a. m.	5:50 a. m.	0.84	4:18 a. m.	5:10 a. m.	0.02	0.08	0.10	0.18	0.25	0.38	0.54	0.59	0.60	0.66	0.75	0.81			
Devils Lake, N. Dak.	10			0.35														0.29			
Dodge City, Kans.	5			0.49														0.49			
Drexel, Nebr.	3–4	10:00 p. m.	10:00 a. m.	2.18	12:58 a. m.	1:44 a. m.	0.17	0.12	0.24	0.27	0.37	0.49	0.56	0.57	0.62	0.79	0.83				
Dubuque, Iowa.	2			1.67														0.39			
Duluth, Minn.	25			0.56														0.40			
Eastport, Me.	17	7:48 a. m.	D. N. p. m.	3.01	1:59 p. m.	2:18 p. m.	1.45	0.08	0.27	0.39	0.53										
	30	8:40 p. m.	8:10 a. m.	1.31	1:01 a. m.	1:34 a. m.	0.42	0.09	0.23	0.29	0.33	0.42	0.48	0.55							
Elkins, W. Va.	27			0.95														0.55			
El Paso, Tex.	26			0.32														0.29			
Erie, Pa.	6	5:20 p. m.	9:05 p. m.	1.24	7:20 p. m.	7:45 p. m.	0.25	0.19	0.34	0.54	0.70	0.92									
	26	5:34 p. m.	8:05 p. m.	1.47	6:33 p. m.	6:53 p. m.	0.53	0.11	0.35	0.44	0.52										
Escanaba, Mich.	25			0.69														0.40			
Eureka, Cal.	‡			‡																	
Evansville, Ind.	1			1.37														0.54			
Flagstaff, Ariz.	‡			‡																	
Fort Smith, Ark.	8			0.43														0.43			
Fort Wayne, Ind.	6	D. N. a. m.	D. N. a. m.	0.62	4:40 a. m.	4:52 a. m.	0.04	0.40	0.53	0.57											
	22–23	8:55 p. m.	6:00 a. m.	1.32	3:50 a. m.	4:50 a. m.	0.11	0.07	0.23	0.38	0.43	0.45	0.50	0.57	0.68	0.76	0.84	1.00			
Fort Worth, Tex.	24	5:31 a. m.	9:35 a. m.	1.76	5:55 a. m.	6:28 a. m.	0.01	0.13	0.35	0.69	0.93	1.16	1.39	1.44							
Fresno, Cal.	‡			‡																	
Galveston, Tex.	27			0.65														0.60			
Grand Haven, Mich.	13			0.73														0.35			
Grand Junction, Colo.	4			0.01														0.01			
Grand Rapids, Mich.	6			0.43														0.35			
Green Bay, Wis.	17	8:14 a. m.	10:15 a. m.	0.94	9:37 a. m.	10:04 a. m.	0.06	0.33	0.63	0.75	0.78	0.84	0.88								
Hannibal, Mo.	4	2:52 p. m.	5:22 p. m.	1.39	3:55 p. m.	4:34 p. m.	0.31	0.08	0.32	0.43	0.52	0.68	0.83	0.89	0.96						
	8	6:52 p. m.	8:22 p. m.	0.66	7:07 p. m.	7:34 p. m.	0.01	0.14	0.30	0.39	0.44	0.51	0.55								
Harrisburg, Pa.	2	5:15 p. m.	5:50 p. m.	0.57	5:23 p. m.	5:47 p. m.	0.01	0.08	0.28	0.44	0.51	0.56									
	5	2:42 p. m.	3:45 p. m.	0.64	3:14 p. m.	3:35 p. m.	0.03	0.05	0.15	0.31	0.59	0.61									
Hartford, Conn.	26			1.20														0.73			
Hatteras, N. C.	10–11	8:11 p. m.	11:05 a. m.	3.31	8:48 a. m.	9:15 a. m.	1.47	0.22	0.34	0.44	0.50	0.55	0.61								
	15	8:15 p. m.	D. N. p. m.	2.51	10:11 a. m.	10:58 a. m.	2.22	0.15	0.27	0.37	0.56	0.77	0.81	0.88	0.98	1.06					
					8:26 p. m.	9:51 p. m.	0.02	0.21	0.26	0.32	0.53	0.74	0.98	1.06	1.18	1.26	1.44	1.55	1.76	1.92	
Havre, Mont.	10			0.73														0.14			
Helena, Mont.	10			0.69														0.22			
Houghton, Mich.	16			0.66														0.25			
Houston, Tex.	27			0.68														0.55			
Huron, S. Dak.	10	9:50 p. m.	D. N. p. m.	0.73	10:07 p. m.	10:22 p. m.	0.01	0.13	0.30	0.52											
Independence, Cal.																					
Indianapolis, Ind.	5			1.35														0.57			
Iola, Kans.	8	2:30 p. m.	3:08 p. m.	0.72	2:35 p. m.	2:48 p. m.	0.02	0.24	0.56	0.69											
Jacksonville, Fla.	4	5:20 a. m.	7:50 a. m.	1.59	5:39 a. m.	6:24 a. m.	0.08	0.08	0.18	0.47	0.74	0.89	1.02	1.11	1.20	1.28					
	30	10:50 a. m.	1:10 p. m.	0.99	11:26 a. m.	11:46 a. m.	0.10	0.26	0.55	0.70	0.81										

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during June, 1917, at all stations furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Kalispell, Mont.	11			0.56														0.20			
Kansas City, Mo.	1	6:40 p. m.	8:03 p. m.	1.30	6:59 p. m.	7:37 p. m.	0.17	0.06	0.17	0.31	0.45	0.58	0.77	1.00	1.10						
	5	6:30 p. m.	7:25 p. m.	0.59	6:42 p. m.	7:10 p. m.	0.03	0.07	0.12	0.17	0.32	0.46	0.55								
Keokuk, Iowa	4	11:40 a. m.	6:30 p. m.	1.95	1:27 p. m.	1:52 p. m.	0.26	0.21	0.53	0.89	0.97	1.04									
	4	6:50 p. m.	10:45 p. m.	1.52	9:47 p. m.	10:20 p. m.	0.41	0.25	0.50	0.58	0.59	0.75	0.97	1.06							
Key West, Fla.	27–28	9:15 a. m.	D. N. a. m.	1.18	9:28 a. m.	9:44 p. m.	0.05	0.29	0.52	0.66	0.70										
	22	11:15 a. m.	12:57 p. m.	0.85	11:21 a. m.	11:41 a. m.	0.02	0.17	0.35	0.56	0.77										
Knoxville, Tenn.	19	1:40 p. m.	5:30 p. m.	1.36	1:44 p. m.	2:11 p. m.	0.01	0.26	0.34	0.38	0.41	0.48	0.55								
	29	D. N. a. m.	6:40 a. m.	1.15	3:08 a. m.	3:33 a. m.	0.34	0.15	0.27	0.41	0.59	0.72									
	29	1:35 p. m.	2:15 p. m.	0.79	1:45 p. m.	2:08 p. m.	0.01	0.20	0.38	0.52	0.62	0.76									
La Crosse, Wis.	28	6:06 p. m.	6:30 p. m.	0.62	6:06 p. m.	6:22 p. m.	0.00	0.25	0.53	0.60	0.61										
Lander, Wyo.	12			0.07														0.04			
Lansing, Mich.	28	5:50 p. m.	9:00 p. m.	0.78	6:36 p. m.	6:45 p. m.	0.04	0.29	0.49												
Lewiston, Idaho.	2			0.14														0.10			
Lexington, Ky.	9			1.32														0.55			
Lincoln, Nebr.	26–27	9:45 p. m.	6:44 a. m.	1.93	10:26 p. m.	11:29 p. m.	0.01	0.06	0.20	0.29	0.36	0.38	0.39	0.40	0.40	0.47	0.56	0.96	1.06		
					1:53 a. m.	2:22 a. m.	1.16	0.13	0.33	0.42	0.54	0.64	0.72								
Little Rock, Ark.	7–8	9:30 p. m.	D. N. a. m.	0.81	1:17 a. m.	1:28 a. m.	0.06	0.21	0.56	0.58											
	8	6:47 p. m.	D. N. p. m.	1.14	8:17 p. m.	8:46 p. m.	0.06	0.10	0.25	0.58	0.62	0.67	0.85								
Los Angeles, Cal.	‡			‡														0.45			
Louisville, Ky.	1			0.81														0.58			
Ludington, Mich.	28			0.77																	
Lynchburg, Va.	28	4:40 p. m.	5:35 p. m.	1.79	4:45 p. m.	5:12 p. m.	0.01	0.28	0.66	1.19	1.56	1.67	1.73					0.10			
Macon, Ga.	10			0.11																	
Madison, Wis.	23	2:50 a. m.	7:00 a. m.	1.05	5:02 a. m.	5:18 a. m.	0.03	0.08	0.36	0.60	0.63							0.20			
Marquette, Mich.	19			0.41														0.40			
Memphis, Tenn.	3			0.68														0.04			
Meridian, Miss.	28			0.11																	
Miami, Fla.	15	1:26 p. m.	3:10 p. m.	1.43	1:26 p. m.	1:54 p. m.	0.00	0.08	0.23	0.45	0.65	0.90	0.98								
	26	D. N. a. m.	6:25 a. m.	1.20	1:14 a. m.	1:38 a. m.	0.01	0.17	0.35	0.53	0.70	0.77									
	12–13	8:10 p. m.	D. N. a. m.	1.16	12:41 a. m.	1.25 a. m.	0.24	0.13	0.29	0.40	0.48	0.53	0.64	0.69	0.77	0.84					
					11:57 p. m.	12.47 a. m.	0.03	0.05	0.11	0.16	0.20	0.40	0.64	0.86	1.16	1.37	1.64				
Milwaukee, Wis.	22–23	11:40 p. m.	8:00 a. m.	5.21	12:47 a. m.	1.37 a. m.	.....	1.76	1.86	1.91	1.92	1.99	2.10	2.16	2.27	2.51	2.83				
					1:37 a. m.	2.47 a. m.	.....	3.07	3.18	3.20	3.24	3.26	3.28	3.30	3.31	3.36	3.43				
					2:27 a. m.	2:50 a. m.	.....	3.50	3.68	3.90	4.11	4.19									
Minneapolis, Minn.	24–25	11:25 p. m.	5:20 a. m.	1.25	3:48 a. m.	4:20 a. m.	0.32	0.25	0.45	0.51	0.59	0.67	0.74	0.78							
Mobile, Ala.	11			0.84														0.66			
Modena, Utah	4			T.														T.			
Montgomery, Ala.	29			0.45														0.42			
Moorhead, Minn.	11	10:15 a. m.	2:50 p. m.	0.82	1:31 p. m.	1:43 p. m.	0.04	0.29	0.53	0.58											
Mount Tamalpais, Cal.	‡			‡																	
Nantucket, Mass.	11–12	11:20 p. m.	3:50 a. m.	1.66	12:54 a. m.	1:45 a. m.	0.12	0.09	0.27	0.68	0.89	1.00	1.13	1.20	1.31	1.40	1.46	1.50			
Nashville, Tenn.	2	1:08 a. m.	D. N. a. m	0.67	1:11 a. m.	1:28 a. m.	0.01	0.30	0.48	0.58	0.62										
	6–7	9:30 p. m.	D. N. a. m	2.73	11:09 p. m.	12:38 a. m.	0.14	0.07	0.28	0.54	0.66	0.68	0.70	0.81	0.84	0.92	1.00	1.24	2.31	2.49	
	27	2:57 p. m.	3:55 p. m.	0.76	3:00 p. m.	3:30 p. m.	0.03	0.06	0.25	0.35	0.38	0.59	0.69								
Needles, Cal.	‡			‡																	
New Haven, Conn.	26–27			0.86														0.60			
New Orleans, La.	13	6:17 p. m.	7:45 p. m.	0.69	6:37 p. m.	6:58 p. m.	0.06	0.14	0.28	0.41	0.55	0.59									
	28	11:05 a. m.	2:30 p. m.	1.88	11:29 a. m.	12:25 p. m.	0.04	0.05	0.19	0.66	0.89	1.06	1.20	1.41	1.54	1.61	1.68	1.78			
New York, N. Y.	14	1:54 p. m.	6:55 p. m.	3.86	2:03 p. m.	4:03 p. m.	T.	0.05	0.10	0.17	0.30	0.51	0.83	1.12	1.48	1.70	1.93	2.00	2.34	3.05	3.50
Norfolk, Va.	1			1.17														0.90			
Northfield, Vt.	8			0.59														0.48			
North Head, Wash.	21			0.30														0.21			
North Platte, Nebr.	4–5	7:45 p. m.	4:15 a. m.	1.02	7:57 p. m.	8:25 p. m.	0.01	0.10	0.25	0.36	0.49	0.54	0.60								
Oklahoma, Okla.	23			0.60														0.32			
Omaha, Nebr.	4			1.35														0.67			
Oswego, N. Y.	7	3:16 p. m.	4:50 p. m.	0.76	3:48 p. m.	4:00 p. m.	0.03	0.31	0.61	0.67											
Palestine, Tex.	2–3	7:05 p. m.	D. N. a. m.	2.26	7:54 p. m.	9:14 p. m.	0.13	0.06	0.13	0.27	0.33	0.42	0.59	0.81	1.04	1.06	1.07	1.13	1.60		
	27	4:38 p. m.	4:58 p. m.	0.68	4:38 p. m.	4:58 p. m.	0.00	0.30	0.47	0.58	0.68										
Parkersburg, W. Va.	27	2:14 p. m.	3:37 p. m.	0.67	2:23 p. m.	2:40 p. m.	0.01	0.24	0.43	0.54	0.57										
Pensacola, Fla.	14	2:55 p. m.	3:55 p. m.	0.72	3:11 p. m.	3:28 p. m.	0.01	0.26	0.51	0.63	0.67										
	28	7:40 a. m.	9:30 a. m.	1.91	7:56 a. m.	8:39 a. m.	0.12	0.12	0.40	0.58	0.69	0.93	1.22	1.46	1.67	1.73					
Peoria, Ill.	12	1:50 a. m.	3:00 a. m.	1.24	1:57 a. m.	2:46 a. m.	0.05	†	†	†	†	†	†	†	†	1.12	1.18				
Philadelphia, Pa.	7			1.12														0.36			
Phoenix, Ariz.	‡			‡																	
Pierre, S. Dak.	5			0.26														0.26			
Pittsburgh, Pa.	6	10:35 a. m.	11:10 a. m.	0.76	10:41 a. m.	10:54 a. m.	0.02	0.22	0.60	0.73											
	23	9:28 p. m.	11:50 p. m.	1.02	11:03 p. m.	11:24 p. m.	0.44	0.06	0.08	0.27	0.44	0.49									
Pocatello, Idaho.	2			0.16														0.12			
Point Reyes Light, Cal.	‡			‡																	
Port Angeles, Wash.	8			0.21														0.09			
Port Huron, Mich.	26	D. N. a. m.	D. N. a. m.	1.23	12:50 a. m.	1:07 a. m.	0.01	0.15	0.45	0.64	0.69										
		1:09 p. m.	1:42 p. m.	0.59	1:14 p. m.	1:34 p. m.	0.01	0.16	0.31	0.48	0.58										
Portland, Me.	3	10:46 a. m.	12:05 p. m.	0.81	11:17 a. m.	11:47 a. m.	0.11	0.08	0.30	0.44	0.49	0.62	0.67								
Portland, Oreg.	8			0.20														0.10			
Providence, R. I.	10	8:00 a. m.	12:20 p. m.	0.91	9:13 a. m	9:47 a. m.	0.12	0.11	0.20	0.33	0.49	0.59	0.66								
	11	6:28 p. m.	8:20 p. m.	0.58	7:35 p. m.	8:00 p. m.	0.05	0.25	0.39	0.46	0.52										
Pueblo, Colo.	5			0.37														0.36			
Raleigh, N. C.	14	12:27 p. m.	5:55 p. m.	1.72	1:38 p. m.	2:08 p. m.	0.10	0.19	0.22	0.35	0.48	0.63	0.69								
Rapid City, S. Dak.	4			0.50														0.42			
Reading, Pa.	5			0.33														0.31			
Red Bluff, Cal.	‡			‡																	
Reno, Nev.	6			0.06														0.04			
Richmond, Va.	2	6:50 p. m.	8:25 p. m.	0.72	6:59 p. m.	7:22 p. m.	0.03	0.11	0.24	0.27	0.41	0.46									
Rochester, N. Y.	7	7:55 a. m.	9:45 a. m.	0.74	8:20 a. m.	9:00 a. m.	0.03	0.06	0.18	0.28	0.35	0.41	0.47	0.54	0.63						
Roseburg, Oreg.	9			0.18														0.09			
Roswell, N. Mex.	19			T.														T.			
Sacramento, Cal.	‡			‡																	
Saginaw, Mich.	25–26	D. N. p. m.	5:50 a. m.	1.28	11:20 p. m.	11:47 p. m.	0.01	0.15	0.28	0.34	0.46	0.56	0.61								
	26	7:43 a. m.	8:10 a. m.	0.85	7:43 a. m.	8:04 a. m.	0.00	0.24	0.54	0.65	0.82	0.85									
St. Joseph, Mo.	1	12:55 p. m.	9:08 p. m.	2.02	7:57 p. m.	8:43 p. m.	1.30	0.10	0.16	0.22	0.26	0.30	0.32	0.37	0.50	0.67	0.70				
	5	4:58 p. m.	9:15 p. m.	1.37	6:32 p. m.	6:53 p. m.	0.17	0.08	0.30	0.62	0.94	1.00									
St. Louis, Mo.	5			0.29														0.18			
St. Paul, Minn.	25	3:55 a. m.	5:35 a. m.	0.83	4:02 a. m.	4:15 a. m.	0.03	0.27	0.41	0.46											
Salt Lake City, Utah	10			0.17														0.06			
San Antonio, Tex.	24			0.02														0.02			
San Diego, Cal.	6			T.														T.			
Sand Key, Fla.	24	6:40 p. m.	10:20 p. m.	2.18	6:46 p. m.	7:21 p. m.	0.01	0.49	0.87	1.31	1.53	1.75	1.87	1.94							

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during April, 1917, at all stations furnished with self-registering gages*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.												
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Sandusky, Ohio	5	8:30 p. m.	11:45 p. m.	2.10	10:12 p. m.	10:50 p. m.	0.13	0.06	0.32	0.56	0.89	1.30	1.63	1.88	1.93	.....	.....	.....	.....	.....	.....
Sandy Hook, N. J.	11	5:20 a. m.	6:15 a. m.	0.71	5:32 a. m.	5:51 a. m.	0.05	0.10	0.29	0.48	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	14	3:43 p. m.	7:10 p. m.	0.90	4:02 p. m.	4:36 p. m.	0.06	0.06	0.16	0.36	0.44	0.55	0.63	0.67	.....	.....	.....	.....	.....	.....	.....
	29	7:12 p. m.	8:40 p. m.	0.78	7:21 p. m.	7:47 p. m.	0.01	0.27	0.39	0.50	0.60	0.65	0.69	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco, Cal.	6	.....	.....	T.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	T.	.....	.....	.....
San Jose, Cal.	‡	.....	.....	‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Luis Obispo, Cal.	‡	.....	.....	‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Santa Fe, N. Mex.	21	.....	.....	0.06	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.06	.....	.....	.....
Sault Ste. Marie, Mich.	26	.....	.....	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.46	.....	.....	.....
Savannah, Ga.	3–4	11:35 p. m.	D. N. a. m.	0.73	11:42 p. m.	12:07 a. m.	0.02	0.12	0.18	0.27	0.44	0.49	.....	.....	.....	.....	.....	.....	.....	.....	.....
Scranton, Pa.	26	.....	.....	0.68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.53	.....	.....	.....
Seattle, Wash.	23–24	5:45 p. m.	5:15 a. m.	1.10	7:08 p. m.	7:26 p. m.	0.03	0.13	0.35	0.51	0.57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sheridan, Wyo.	11	.....	.....	0.39	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.15	.....	.....	.....
Shreveport, La.	14	.....	.....	0.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.25	.....	.....	.....
Sioux City, Iowa	5	.....	.....	0.84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.55	.....	.....	.....
Spokane, Wash.	23	.....	.....	0.37	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.19	.....	.....	.....
Springfield, Ill.	4	3:55 p. m.	6:38 p. m.	2.00	4:26 p. m.	5:17 p. m.	0.01	0.22	0.57	0.97	1.24	1.32	1.39	1.44	1.58	1.72	1.83	1.86	.....	.....	.....
	4	7:50 p. m.	9:04 p. m.	1.41	8:19 p. m.	8:46 p. m.	0.12	0.21	0.71	1.08	1.17	1.25	1.29	.....	.....	.....	.....	.....	.....	.....	.....
	4–5	9:40 p. m.	D. N. a. m.	2.53	10:55 p. m.	11:23 p. m.	0.81	0.15	0.36	0.48	0.64	0.77	0.84	.....	.....	.....	.....	.....	.....	.....	.....
	13	6:15 a. m.	7:35 a. m.	0.83	6:28 a. m.	6:51 a. m.	0.01	0.15	0.16	0.20	0.45	0.59	.....	.....	.....	.....	.....	.....	.....	.....	.....
	27–28	9:55 p. m.	D. N. a. m.	1.93	11:41 p. m.	12:08 a. m.	0.69	0.13	0.23	0.34	0.46	0.68	0.79	.....	.....	.....	.....	.....	.....	.....	.....
Springfield, Mo.	8	.....	.....	0.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.47	.....	.....	.....
Syracuse, N. Y.	7	.....	.....	0.54	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.48	.....	.....	.....
Tacoma, Wash.	29	.....	.....	0.62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.45	.....	.....	.....
Tampa, Fla.	27	12:29 p. m.	5:10 p. m.	2.23	12:32 p. m.	1:04 p. m.	0.01	0.20	0.34	0.52	0.74	1.07	1.44	1.52	.....	.....	.....	.....	.....	.....	.....
Tatoosh Island, Wash.	21	.....	.....	0.72	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.15	.....	.....	.....
Taylor, Tex.	2	.....	.....	0.31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.31	.....	.....	.....
Terre Haute, Ind.	4–5	7:05 p. m.	6:28 a. m.	3.38	7:46 p. m.	8:11 p. m.	0.08	0.20	0.46	0.65	0.80	0.87	.....	.....	.....	.....	.....	.....	.....	.....	.....
	13	2:15 p. m.	4:30 p. m.	0.90	12:08 a. m.	1:34 a. m.	1.30	0.39	0.58	0.67	0.74	0.84	0.92	0.97	1.00	1.09	1.16	1.25	1.51	1.63	.....
					2:26 p. m.	2:52 p. m.	0.01	0.12	0.34	0.43	0.45	0.65	0.69	.....	.....	.....	.....	.....	.....	.....	.....
Thomasville, Ga.	29	1:15 p. m.	5:30 p. m.	0.89	1:22 p. m.	1:43 p. m.	0.01	0.07	0.28	0.48	0.61	0.6.	.....	.....	.....	.....	.....	.....	.....	.....	.....
Toledo, Ohio	2	1:30 p. m.	2:14 p. m.	0.63	1:58 p. m.	2:12 p. m.	0.03	0.09	0.44	0.59	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	13	4:08 p. m.	5:20 p. m.	0.56	4:18 p. m.	4:38 p. m.	0.01	0.06	0.24	0.40	0.53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Tonopah, Nev.	‡	.....	.....	‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Topeka, Kans.	27–28	5:05 p. m.	D. N. a. m.	1.41	1:56 a. m.	2:20 a. m.	0.58	0.12	0.26	0.53	0.60	0.69	.....	.....	.....	.....	.....	.....	.....	.....	.....
Trenton, N. J.	14	.....	.....	1.02	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.62	.....	.....	.....
Valentine, Nebr.	19	.....	.....	0.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.26	.....	.....	.....
Vicksburg, Miss.	9	.....	.....	0.56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.56	.....	.....	.....
Walla Walla, Wash.	9	.....	.....	0.33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.08	.....	.....	.....
Washington, D. C.	6	6:10 p. m.	7:50 p. m.	1.32	6:20 p. m.	7:10 p. m.	0.01	0.15	0.34	0.58	0.76	0.95	1.04	1.09	1.13	1.18	1.25	.....	.....	.....	.....
	14	12:31 p. m.	4:50 p. m.	2.69	12:41 p. m.	1:31 p. m.	0.02	0.20	0.52	0.73	0.93	1.22	1.64	2.00	2.26	2.38	2.44	.....	.....	.....	.....
	27	2:52 p. m.	3:10 p. m.	0.51	2:52 p. m.	3:01 p. m.	0.00	0.20	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wausau, Wis.	6–7	.....	.....	1.16	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.25	.....	.....	.....
Wichita, Kans.	1	.....	.....	0.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.07	.....	.....	.....
Williston, N. Dak.	24	.....	.....	0.74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.74	.....	.....	.....
Wilmington, N. C.	8	5:10 p. m.	8:20 p. m.	0.90	5:36 p. m.	5:54 p. m.	0.01	0.27	0.58	0.65	0.68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	10–11	8:56 p. m.	D. N. a. m.	1.91	10:02 p. m.	10:18 p. m.	0.44	0.06	0.25	0.46	0.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winnemucca, Nev.	9	.....	.....	0.34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.13	.....	.....	.....
Wytheville, Va.	10	.....	.....	0.71	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.57	.....	.....	.....
Yankton, S. Dak.	22–23	11:05 p. m.	1:00 a. m.	0.73	11:08 p. m.	11:38 p. m.	0.01	0.16	0.37	0.44	0.46	0.50	0.59	.....	.....	.....	.....	.....	.....	.....	.....
Yellowstone Park, Wyo.	9–10	.....	.....	0.29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	*	.....	.....	.....

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE III.—*Data furnished by the Canadian Meteorological Service, June, 1917.*

Stations.	Altitude above M. S. L.* Jan. 1, 1916.	Pressure.			Temperature.						Precipitation.		
		Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+ mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Feet.	*Inches.*	*Inches.*	*Inches.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*Inches.*	*Inches.*	*Inches.*
St. Johns, N. F.	125	29.88	30.01	+0.10	57.1	+5.5	66.0	48.2	85	34	3.72	+1.20	.....
Sydney, C. B. I.	48	30.06	30.10	+ .15	58.1	+2.7	69.6	46.6	82	34	2.06	−1.17	.....
Halifax, N. S.	88	29.98	30.08	+ .13	56.8	−0.9	66.4	47.2	82	34	3.36	−0.40	.....
Yarmouth, N. S.	65	29.97	30.04	+ .09	54.1	−0.9	62.6	46.1	70	35	3.46	+0.70	.....
Charlottetown, P. E. I.	38	30.00	30.04	+ .12	59.9	+2.5	67.9	51.9	78	38	2.50	−0.17	.....
Chatham, N. B.	28	30.00	30.02	+0.13	61.8	+1.8	71.9	51.7	87	40	4.61	+1.15	.....
Father Point, Que.	20	29.95	29.97	+ .10	53.2	+0.2	60.9	45.6	73	36	5.38	+2.40	.....
Quebec, Que.	296	29.65	29.97	+ .05	60.1	−1.1	68.2	52.0	79	43	8.60	+4.95	.....
Montreal, Que.	187	29.75	29.95	+ .01	62.3	−2.6	70.1	54.6	82	46	4.98	+1.45	.....
Stonecliffe, Ont.	489	29.33	29.93	− .01	62.8	+1.2	70.9	54.7	90	42	2.37	−0.79	.....
Ottawa, Ont.	236	29.68	29.94	0.00	62.3	−3.0	71.4	53.2	84	38	2.81	−0.11	.....
Kingston, Ont.	285	29.67	29.98	+ .01	59.2	−4.2	67.2	51.3	79	43	5.07	+2.64	.....
Toronto, Ont.	379	29.57	29.97	.00	60.8	−2.6	70.7	51.0	83	41	5.39	+2.59	.....
White River, Ont.	1,244	28.61	29.92	+ .02	51.9	−6.8	65.8	38.0	85	24	1.51	−0.71	.....
Port Stanley, Ont.	592	29.36	30.00	+ .03	59.2	−4.6	67.9	50.6	76	40	4.62	+1.89	.....
Southampton, Ont.	656	29.27	.....	.....	56.8	−3.6	66.4	47.2	82	40	3.97	+1.62	.....
Parry Sound, Ont.	688	29.29	29.97	+0.01	59.0	−2.7	69.4	48.5	84	38	4.99	+2.57	.....
Port Arthur, Ont.	644	29.23	29.94	.00	52.8	−3.6	62.3	43.3	78	34	1.17	−1.56	.....
Winnipeg, Man.	760	29.04	29.86	− .03	59.6	−2.6	73.2	46.0	94	27	2.13	−1.16	.....
Minnedosa, Man.	1,690	28.08	28.87	− .02	56.8	−2.8	70.7	43.0	93	28	1.59	−1.41	.....
Qu'Appelle, Sask.	2,115	27.62	29.84	−0.03	56.3	−3.6	68.6	44.0	81	31	3.39	−0.03	.....
Medicine Hat, Alberta.	2,144	27.63	29.86	+ .01	66.5	+4.5	75.8	47.2	91	37	1.79	−0.97	.....
Swift Current, Sask.	2,392	27.33	29.87	.00	57.1	−2.9	70.6	43.5	86	33	2.02	−0.65	.....
Calgary, Alberta.	3,428	26.42	29.92	+ .08	54.9	−1.1	67.9	41.9	88	32	1.98	−0.47	.....
Banff, Alberta.	4,521	25.39	29.93	+ .09	50.0	−1.5	62.9	37.2	78	29	2.95	−0 38	1.5
Edmonton, Alberta.	2,150	27.61	29.87	+0.03	55.5	−1.4	68.6	42.5	80	33	1.72	−1.14	.....
Prince Albert, Sask.	1,450	28.33	29.87	.00	56.7	−1.0	69.9	43.6	82	29	2.25	−0.26	.....
Battleford, Sask.	1,592	28.15	29.87	+ .01	59.7	+0.2	69.4	50.0	85	37	0.76	−2.55	.....
Kamloops, B. C.	1,262	28.76	30.05	+ .18	61.2	−2.6	73.0	49.5	90	42	2.53	+1.11	.....
Victoria, B. C.	230	29.86	30.12	+ .11	54.7	−1.6	61.9	47.5	78	43	0.93	−0.27	.....
Barkerville, B. C.	4,180	25.72	30.02	+0.15	47.3	−3.4	58.0	36.5	70	27	5.67	+2.19	.....
Hamilton, Bermuda.	151	30.06	30.22	+ .10	74.3	−0.7	79.1	69.5	83	64	6.08	+0.13	.....
LATE REPORT—MAY, 1917.													
Edmonton, Alberta.	2,150	27.62	29.89	+ .01	50.6	−0.2	62.5	38.7	79	23	0.90	−0.65	0.8

* See Explanation of Tables, this REVIEW for January, 1917, p. 40.

Chart I. Hydrographs of Several Principal Rivers, June, 1917.

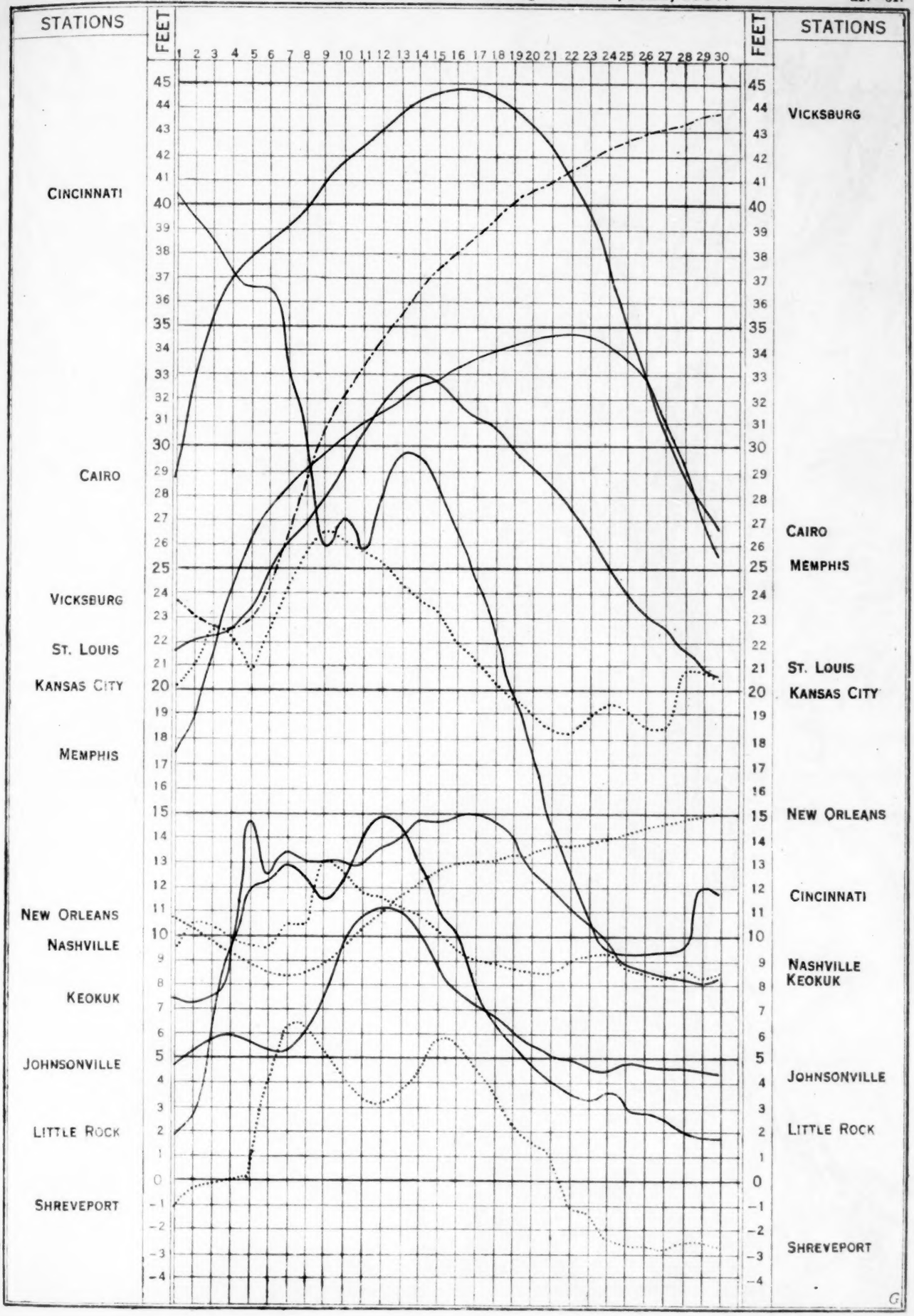

STATIONS
FEET
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
45 44 43 42 41 40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
CINCINNATI
CAIRO
VICKSBURG
ST. LOUIS
KANSAS CITY
MEMPHIS
NEW ORLEANS
NASHVILLE
KEOKUK
JOHNSONVILLE
LITTLE ROCK
SHREVEPORT
VICKSBURG
CAIRO
MEMPHIS
ST. LOUIS
KANSAS CITY
NEW ORLEANS
CINCINNATI
NASHVILLE
KEOKUK
JOHNSONVILLE
LITTLE ROCK
SHREVEPORT

Chart II. Tracks of Centers of High Areas, June, 1917.

(Plotted by Charles A. Donnel.)

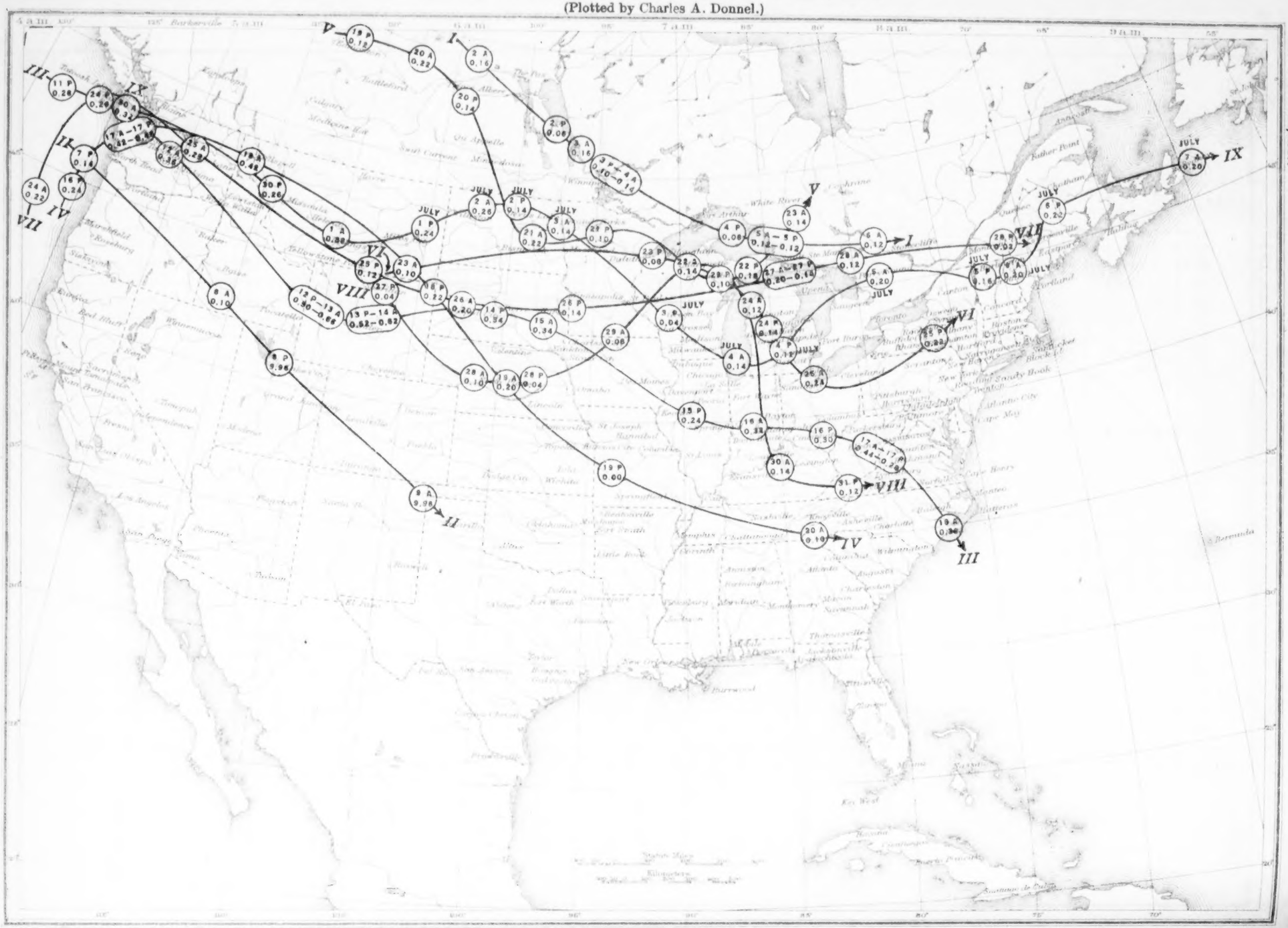


Chart III. Tracks of Centers of Low Areas, June, 1917.

Chart III. Tracks of Centers of Low Areas, June, 1917.

(Plotted by Charles A. Donnel.)

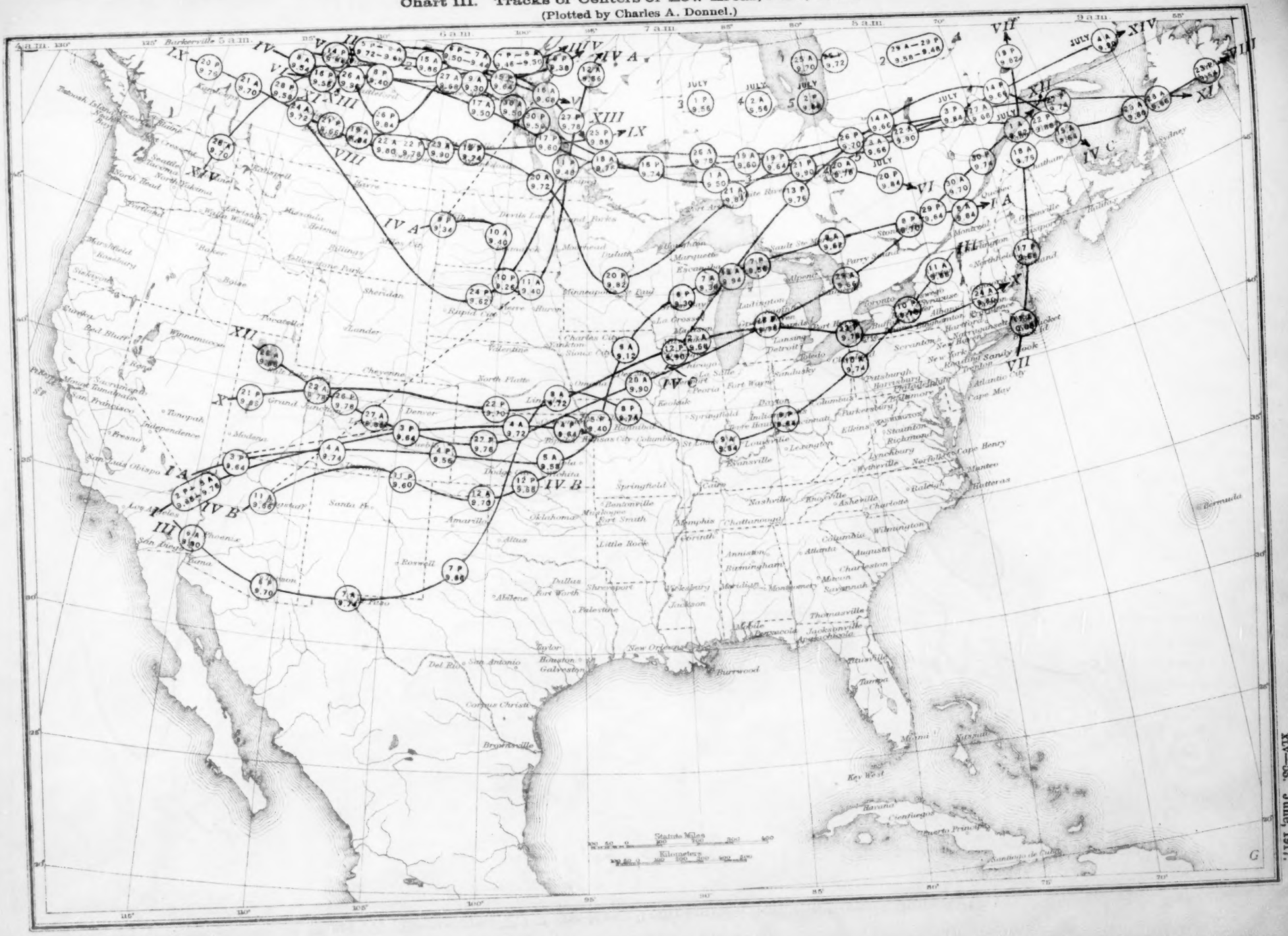


Chart IV. Departure (°F.) of the Mean Temperature from the Normal, June, 1917.

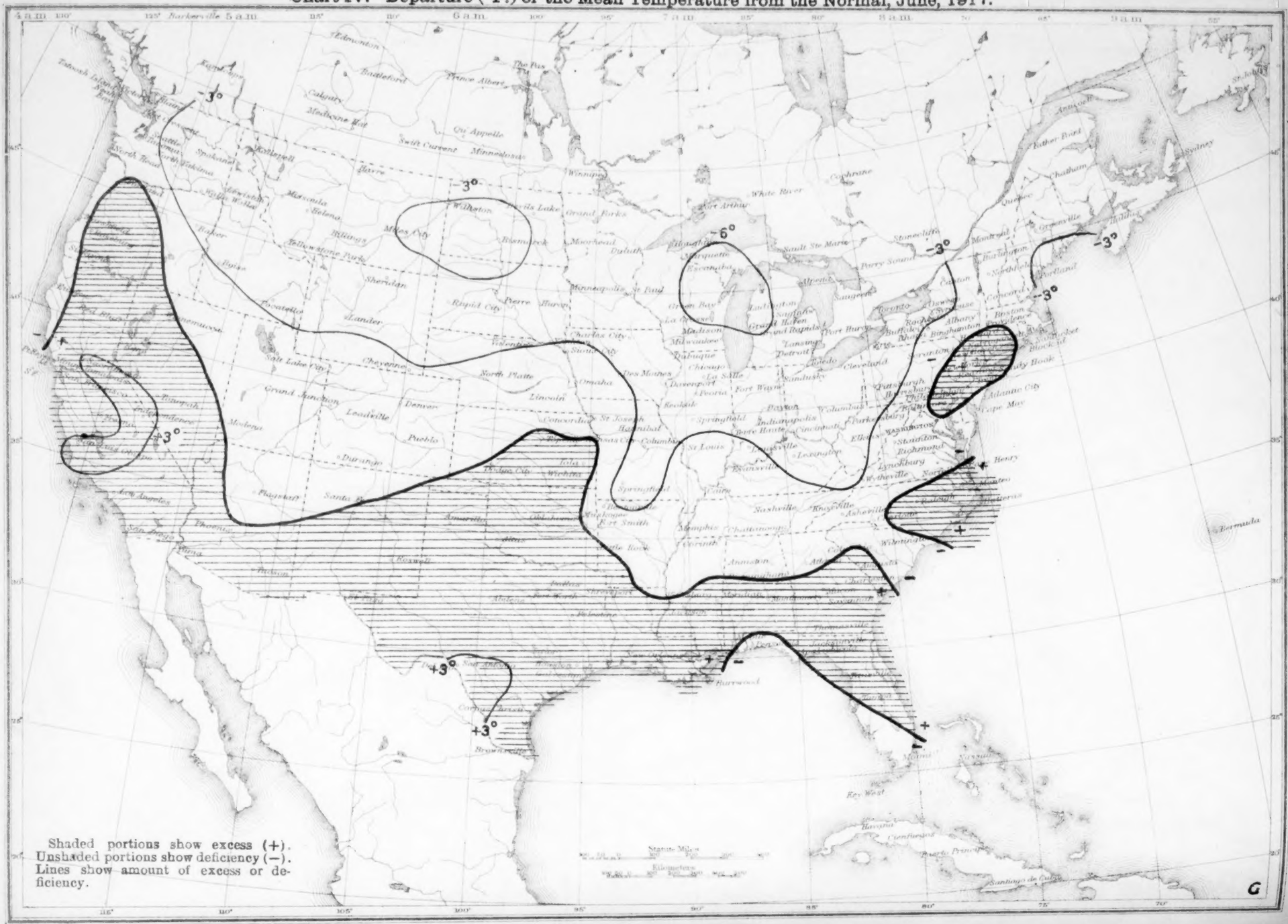


Chart V. Total Precipitation, June, 1917.

Chart V. Total Precipitation, June, 1917.

Chart VI. Percentage of Clear Sky between Sunrise and Sunset, June, 1917.

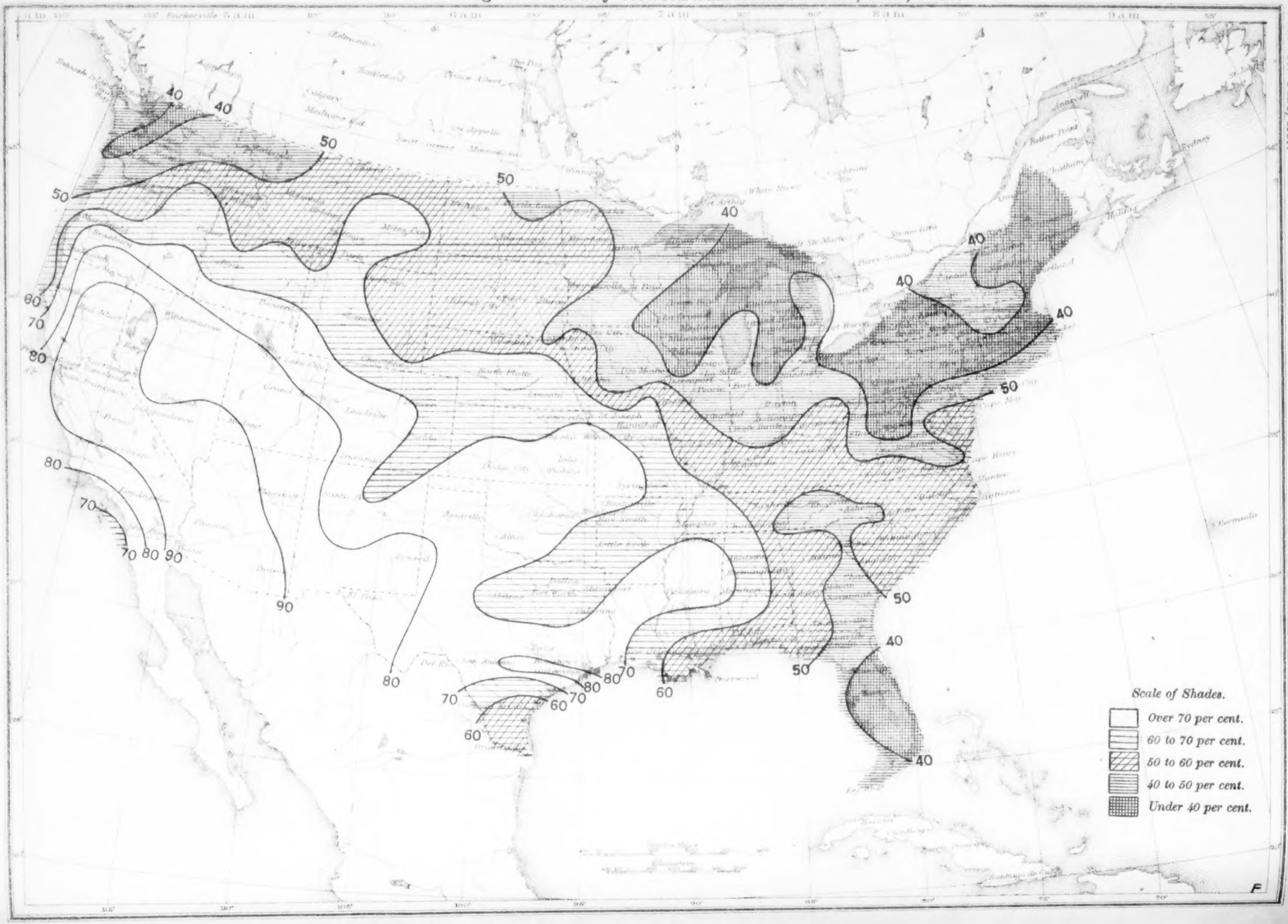


Chart VII. Isobars and Isotherms at Sea Level; Prevailing Winds, June, 1917.

Chart VII. Isobars and Isotherms at Sea Level; Prevailing Winds, June, 1917.

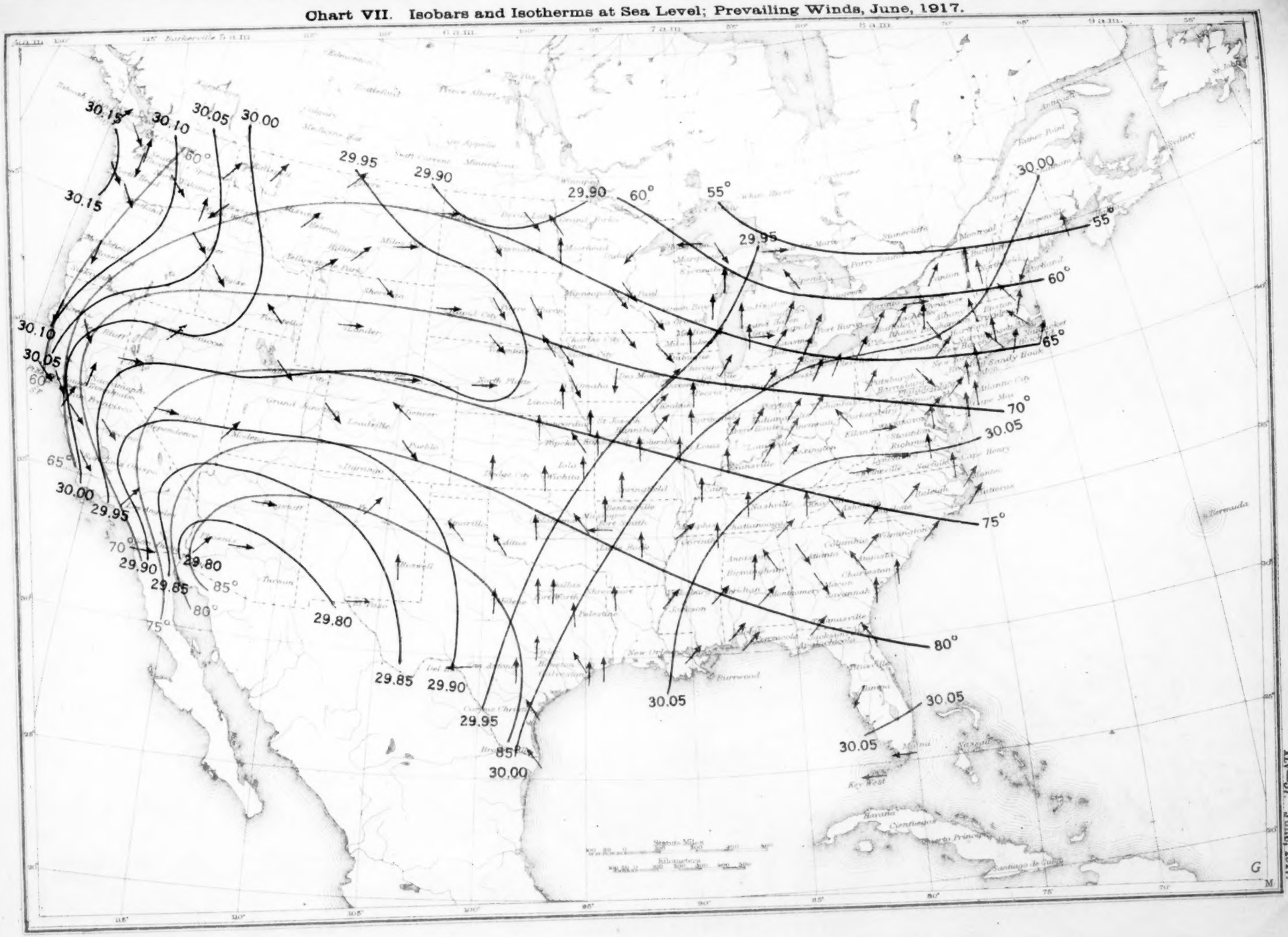
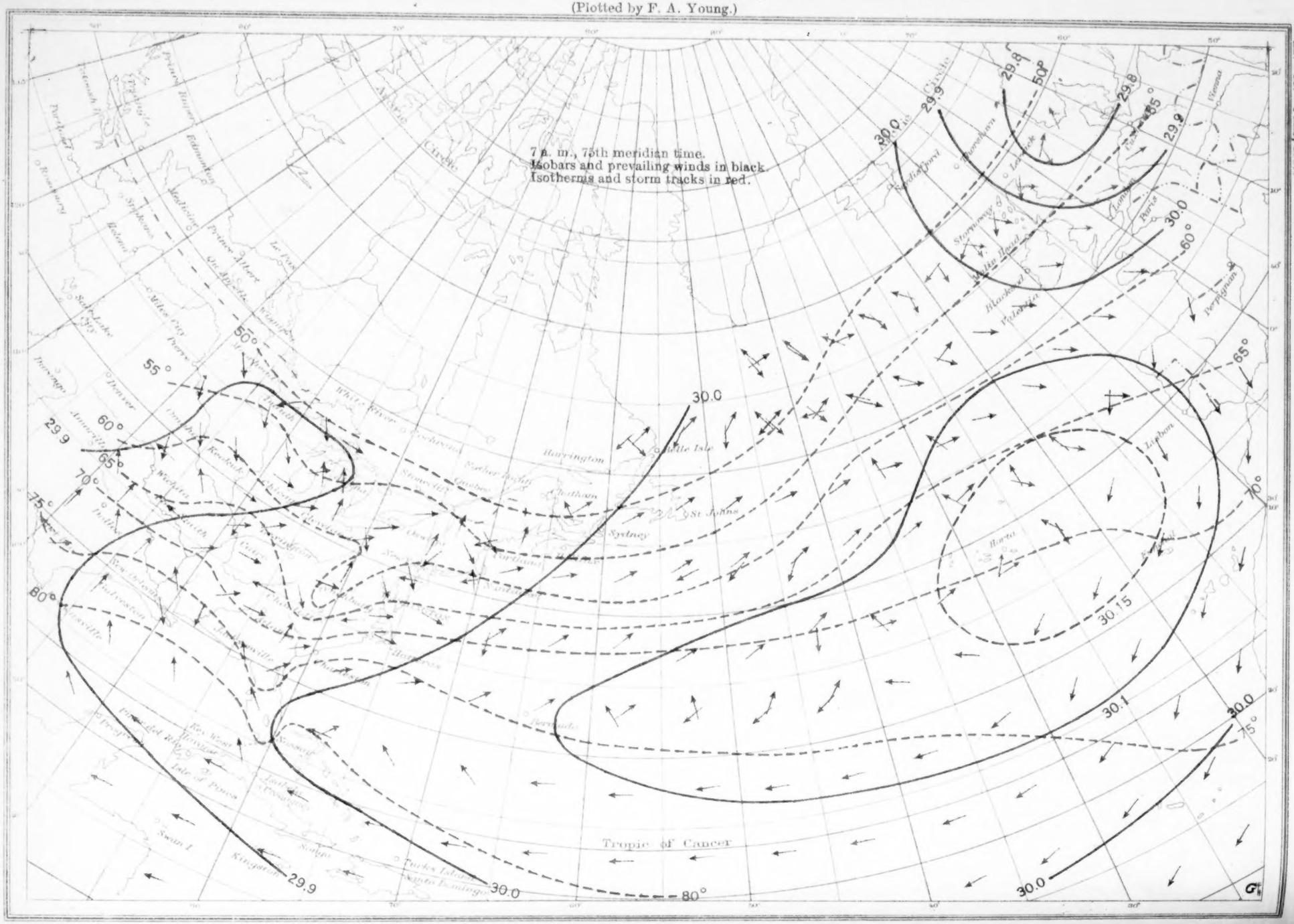
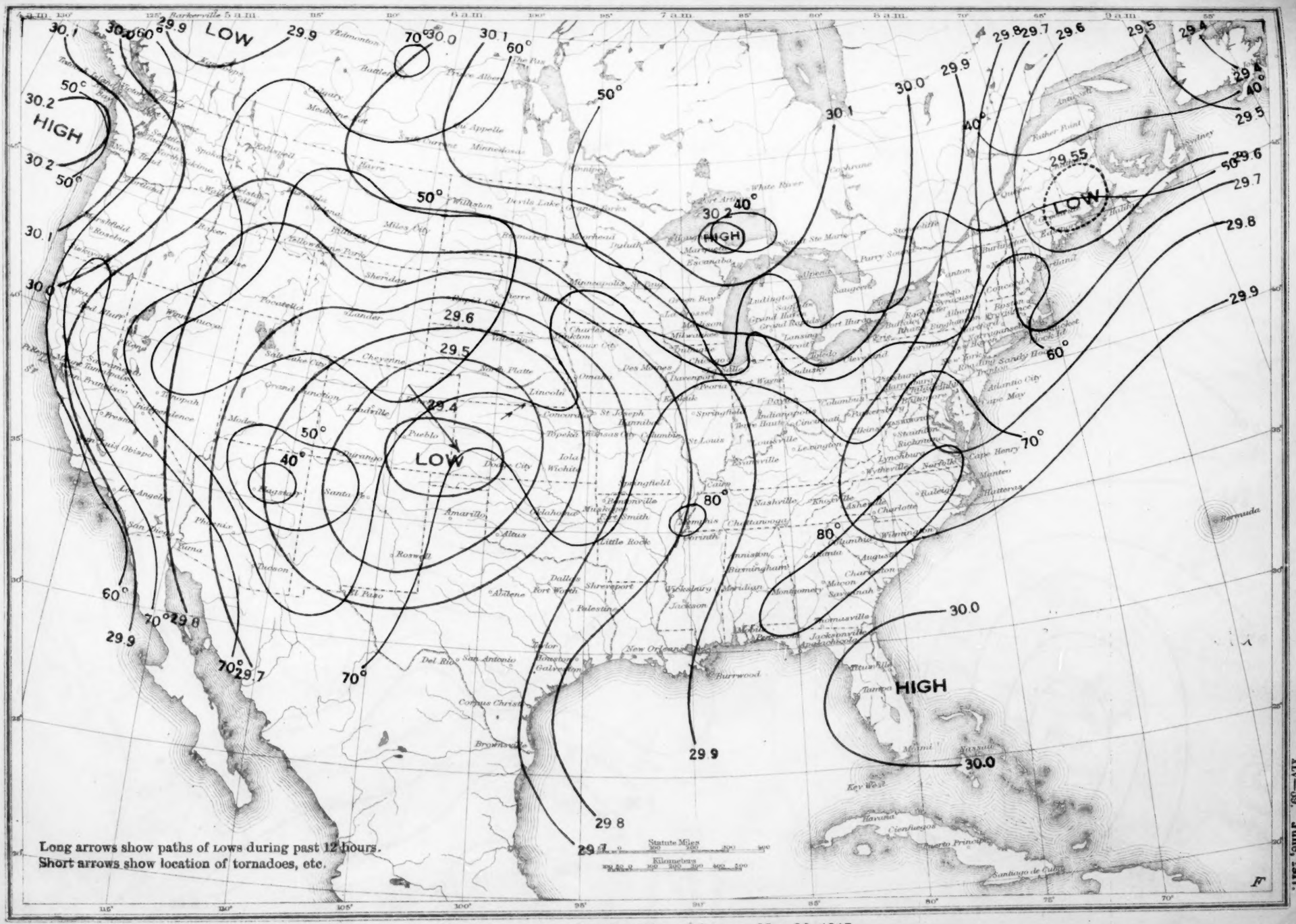


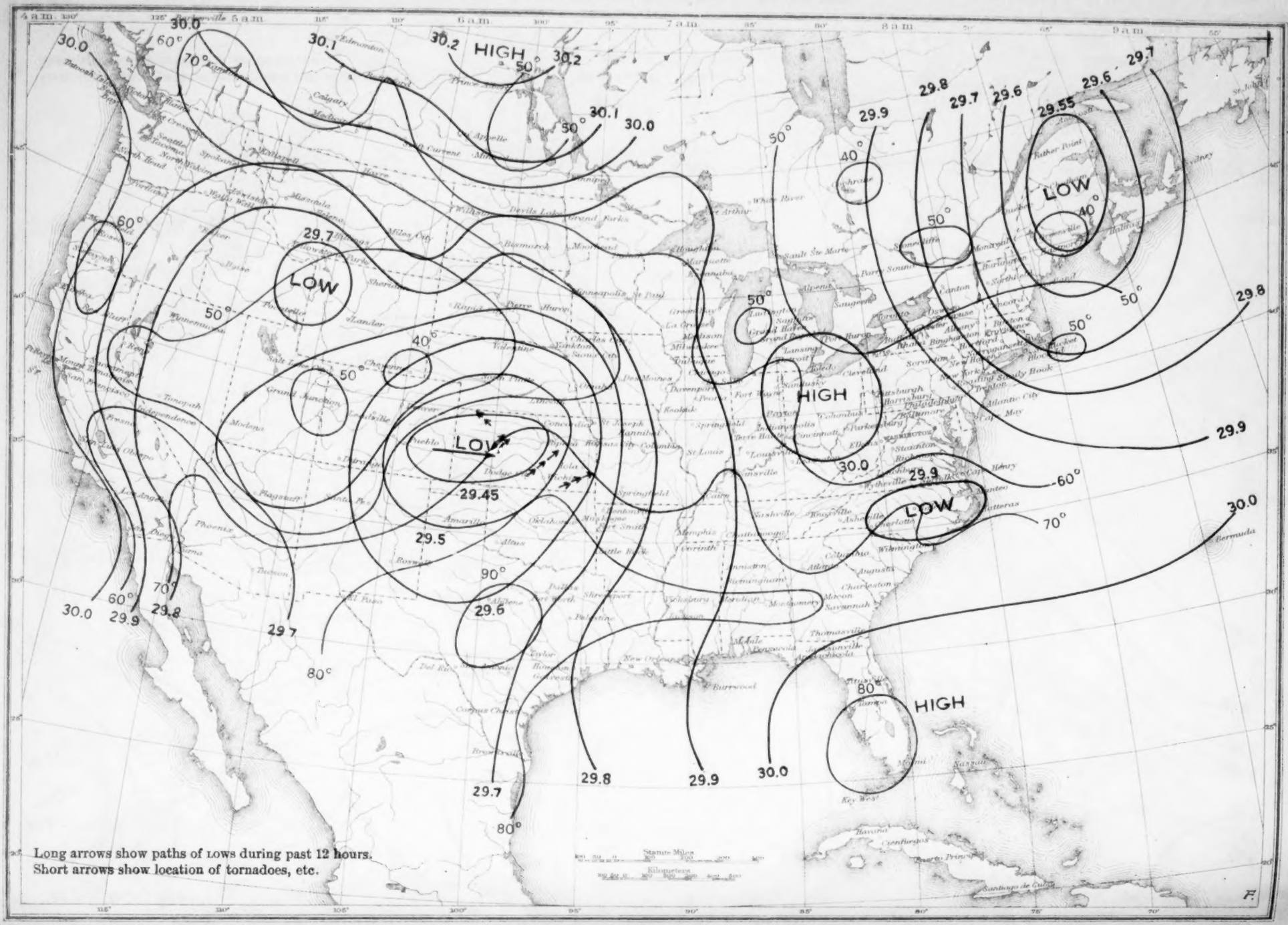
Chart IX. Means of Meteorological Data for North Atlantic Ocean, June, 1916.

(Plotted by F. A. Young.)

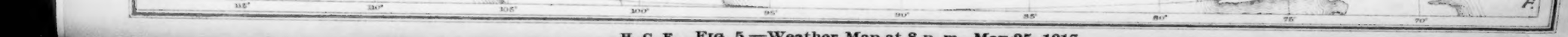




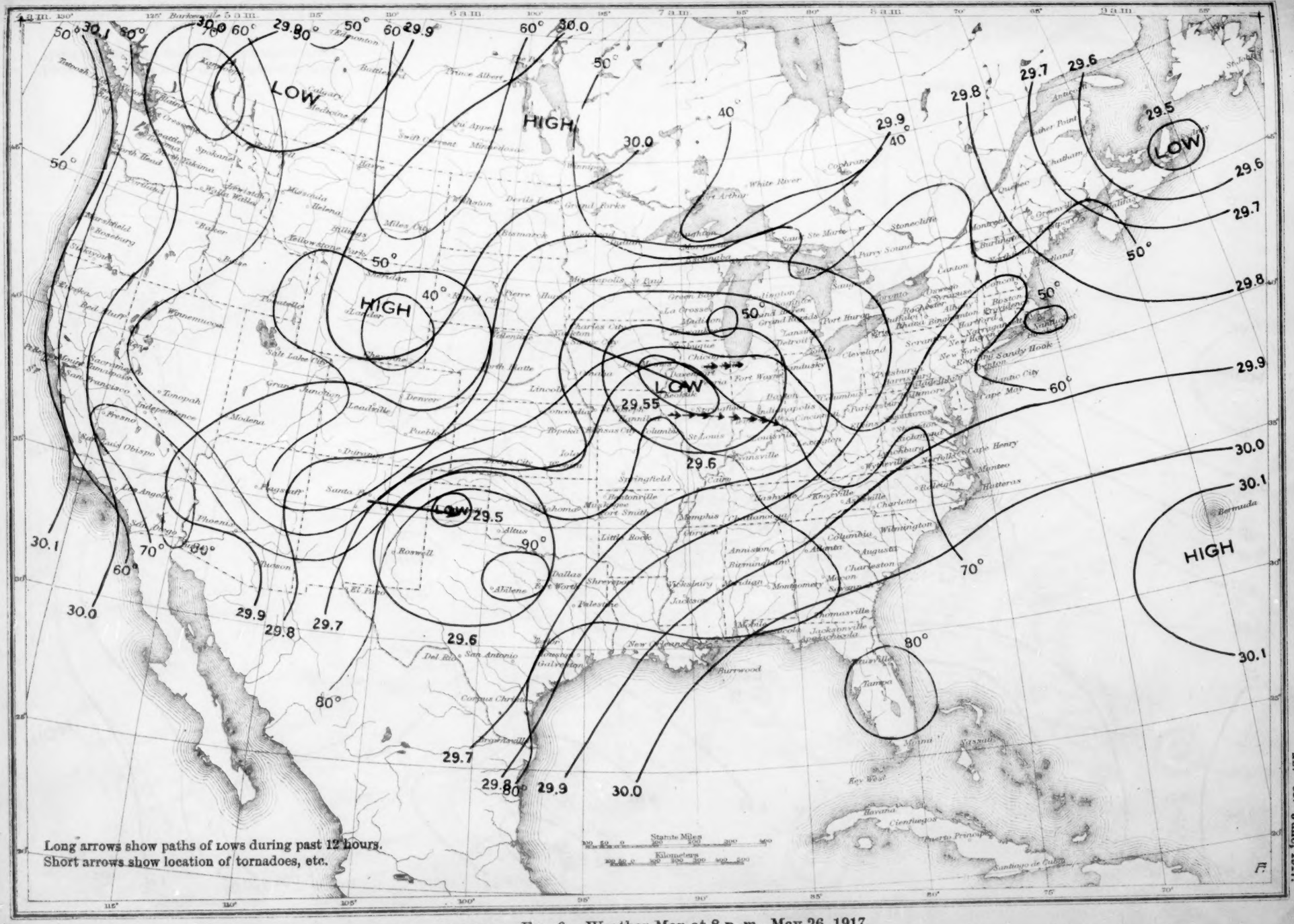
H. C. F. FIG. 4.—Weather Map at 8 p. m., May 20, 1917.



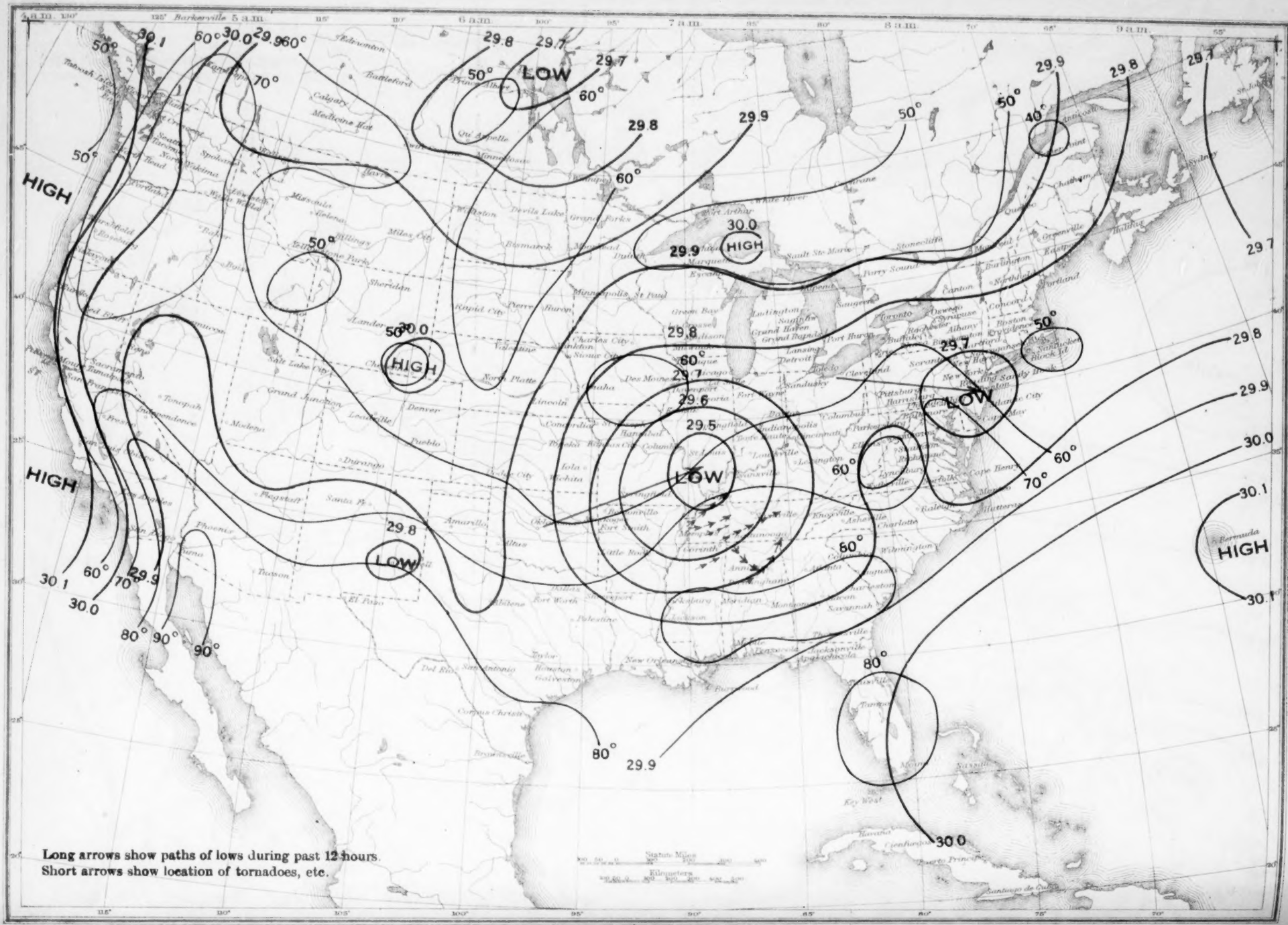
H. C. F. FIG. 5.—Weather Map at 8 p. m., May 25, 1917.



H. C. F. FIG. 5.—Weather Map at 8 p. m., May 25, 1917.

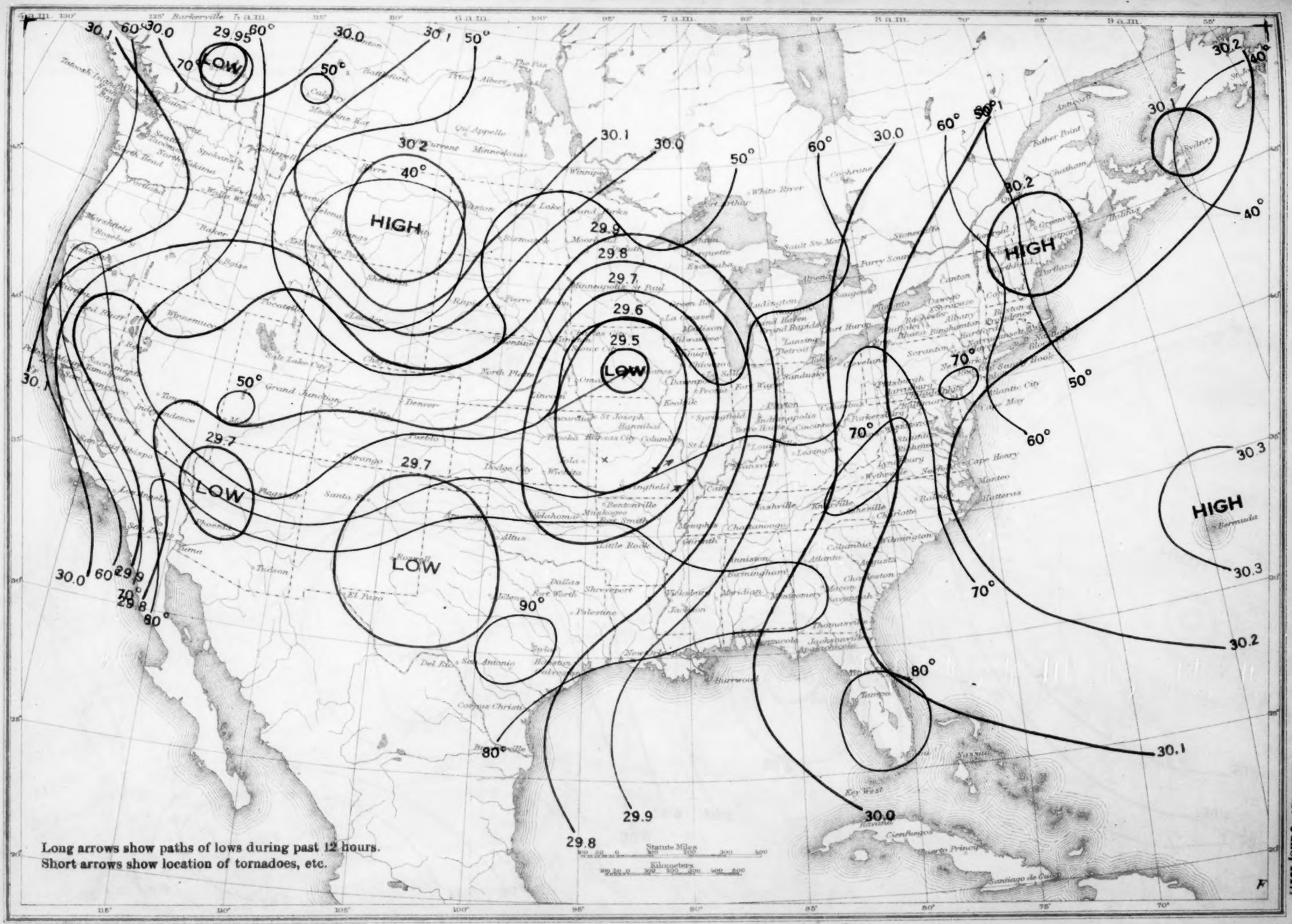


H. C. F. FIG. 6.—Weather Map at 8 p. m., May 26, 1917.

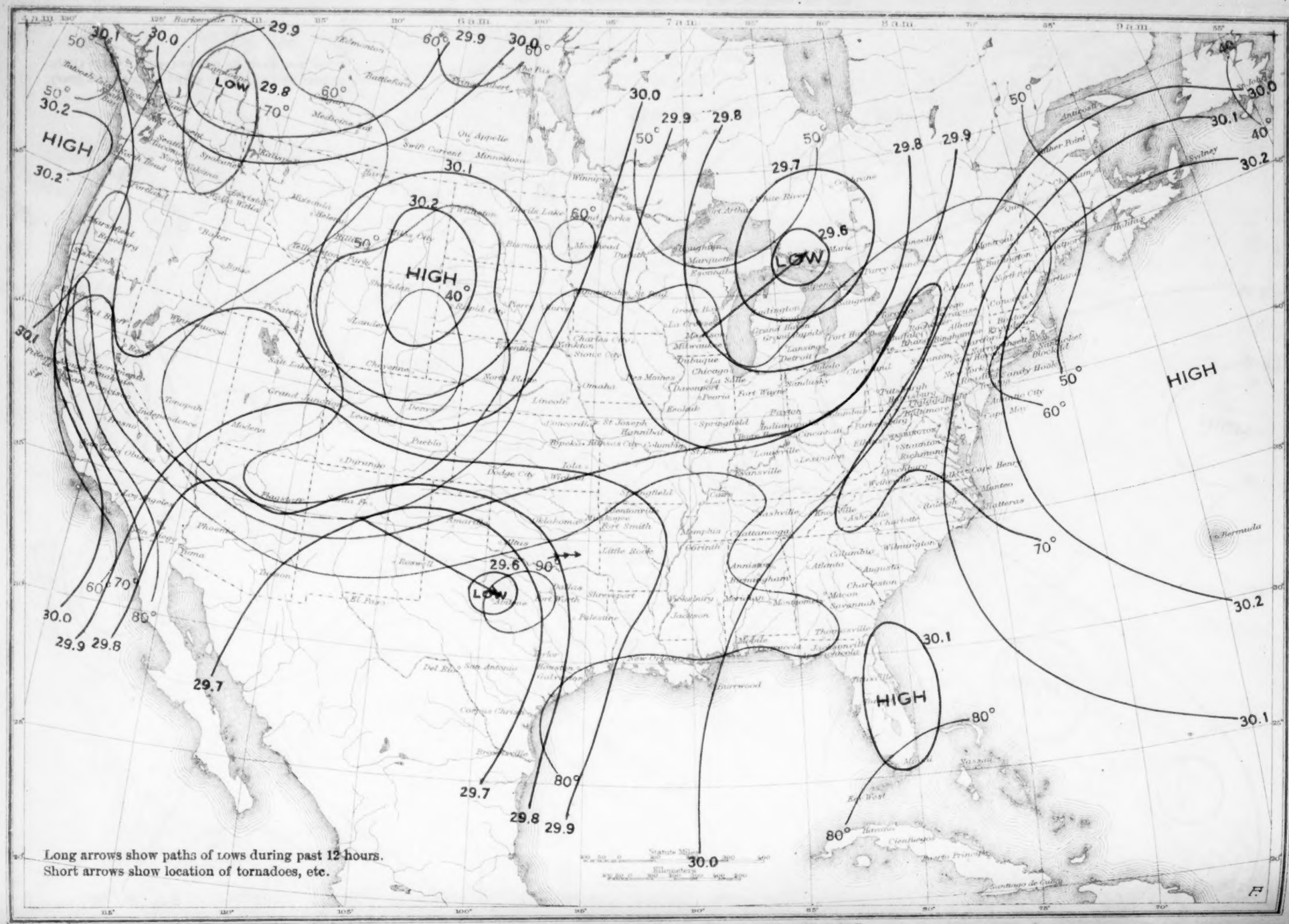


H. C. F. FIG. 7.—Weather Map at 8 p. m., May 27, 1917.

H. C. F. FIG. 7.—Weather Map at 8 p. m., May 27, 1917.

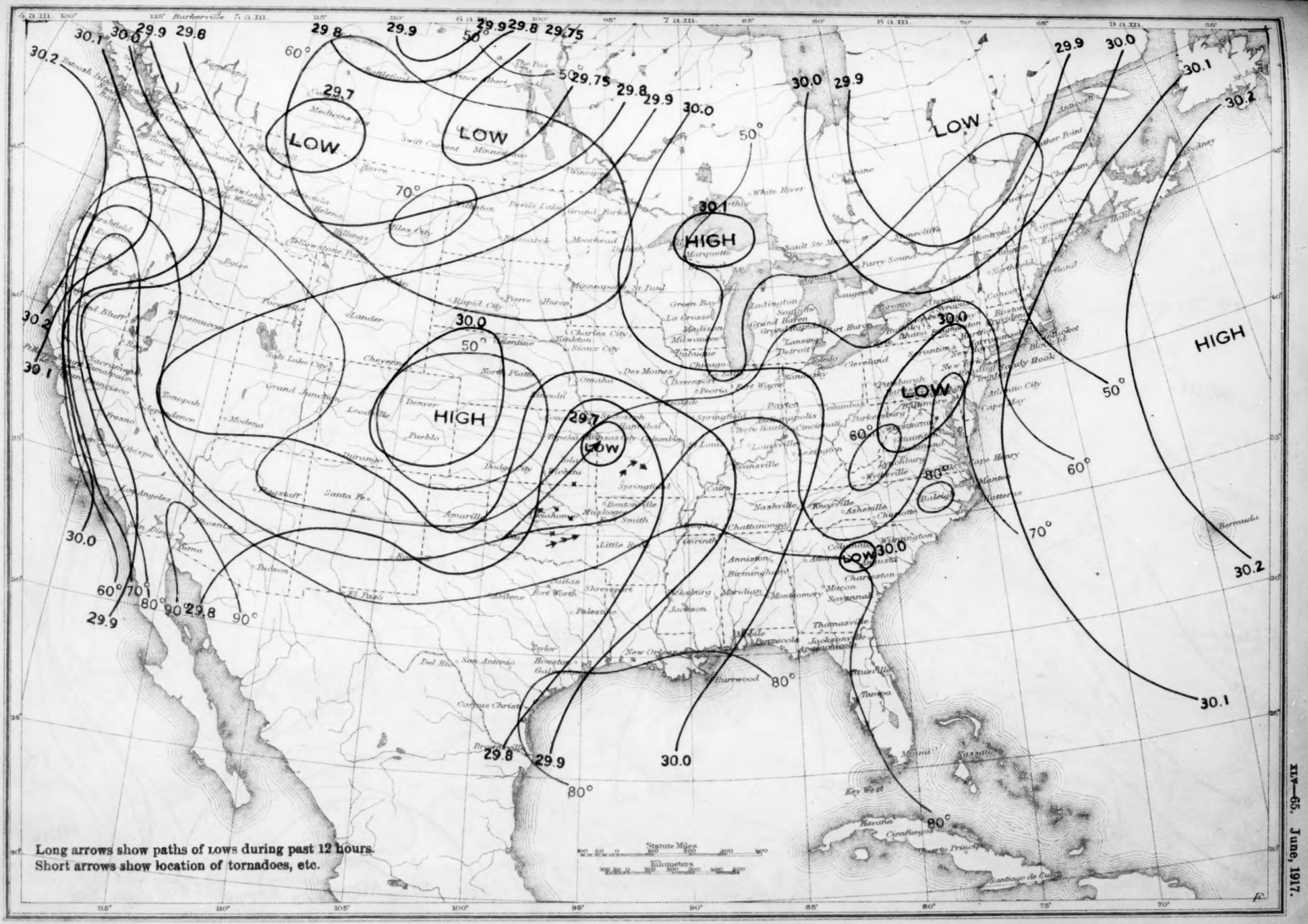


H. C. F. FIG. 8.—Weather Map at 8 p. m., May 30, 1917.

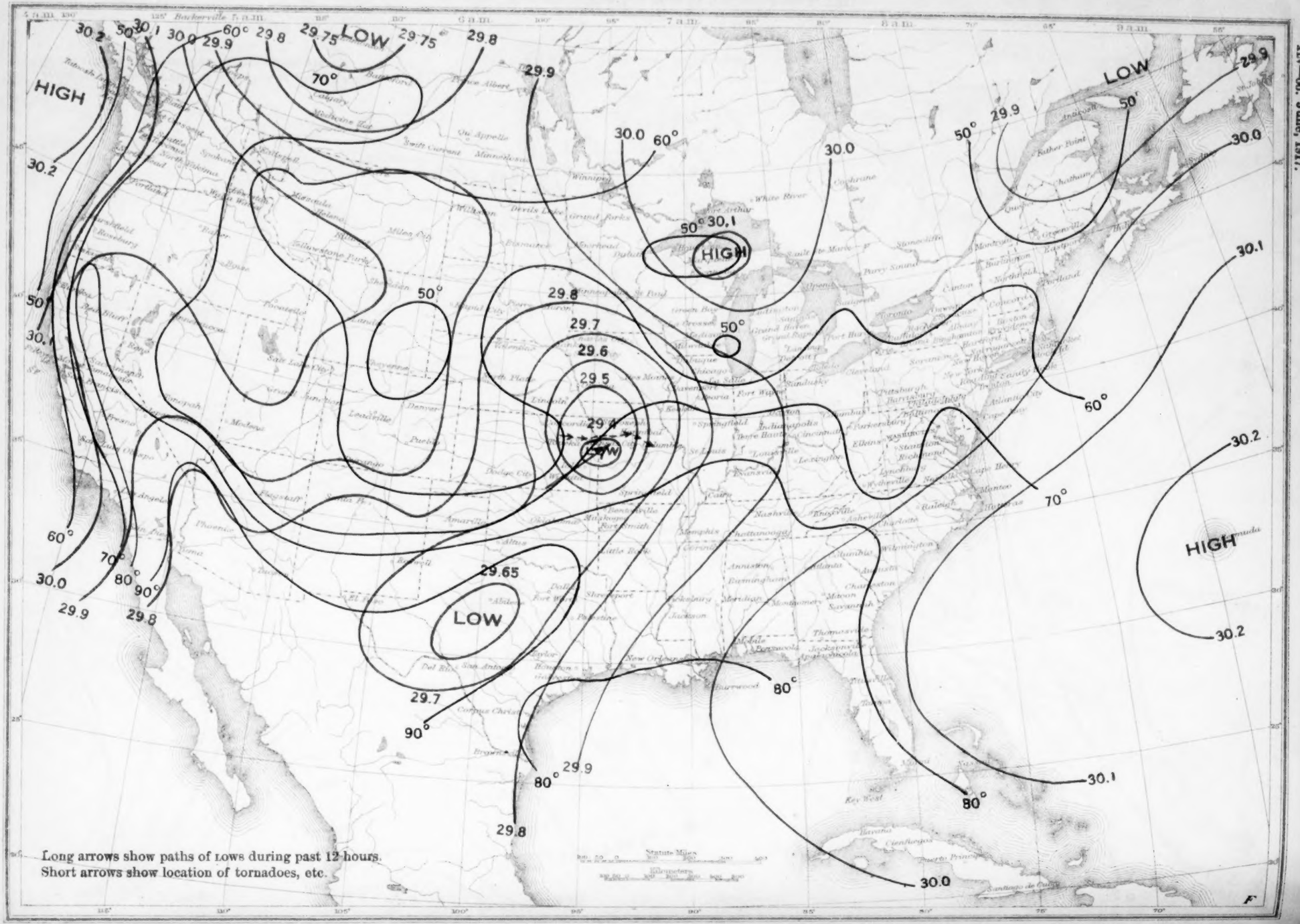


H. C. F. FIG. 9.—Weather Map at 8 p. m., May 31, 1917.

H. C. F. FIG. 9.—Weather Map at 8 p. m., May 31, 1917.

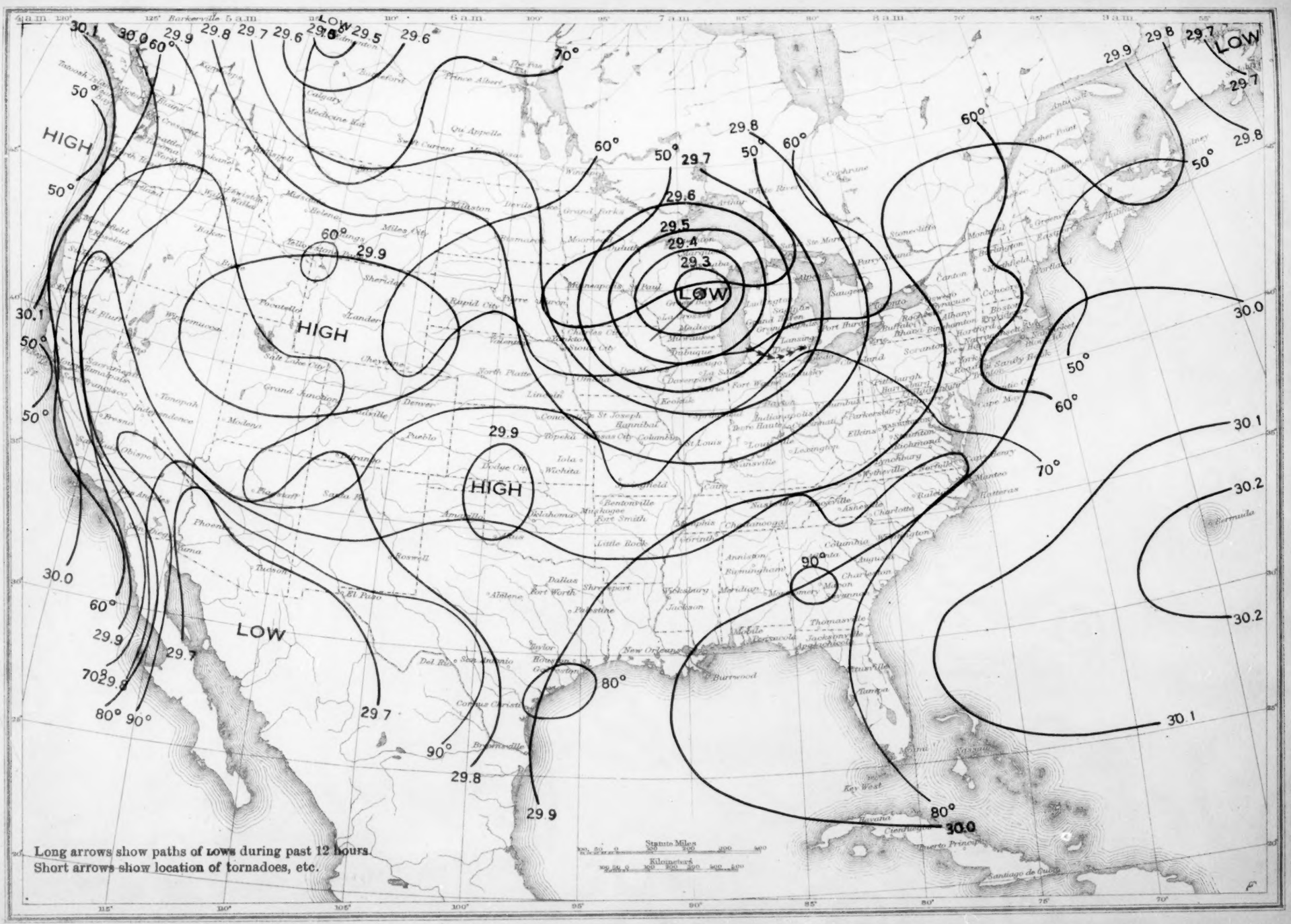


H. C. F. FIG. 10.—Weather Map at 8 p. m., June 1, 1917.



H. C. F. FIG. 11.—Weather Map at 8 p. m., June 5, 1917.

H. C. F. FIG. 11.—Weather Map at 8 p. m., June 5, 1917.



H. C. F. FIG. 12.—Weather Map at 8 p. m., June 6, 1917.